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L.S.

Application of NFDRS Indices

by Larry s. Bradshaw

Final Report for Cooperative AGreement
#INT-88343-COA with
Systems for Environmental Management
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Application of NFDRS Indices

Final Report

Cooperative Aid Agreement INT-88343-COA

Larry S. Bradshaw

In Cooperation with

Patricia L. Andrews

December 1990

SYSTEMS FOR ENVIRONMENTAL MANAGEMENT

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SYSTEMS FOR ENVIRONMENTAL MANAGEMENT

A Natural Resources Research Group

Systems for Environmental Management (SEM) is a non-profit research and educational corporation based in Missoula, Montana, a regional center for natural resources agencies. Founded in 1977, SEM works cooperatively and under contract with the U.S. Forest Service, National Park Service, Bureau of Land Management, and Bureau of Indian Affairs, as well as state and academic institutions, private individuals and organizations.

SEM's diverse professional staff offers a wide range of research capabilities within the natural resources management field. The full-time staff includes specialists in fire behavior, fire history, recreation management, geography, plant ecology, forestry, meteorology, data analysis, and computer science. SEM also maintains a pool of professional affiliates that can be utilized for projects requiring additional expertise. Areas of recent research emphasis include wilderness recreation management, fire history and ecology, fire planning, and development of computerized resource management tools.

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Preface

This report is submitted in fulfillment of section III paragraph B of cooperative aid agreement INT-88343-COA, "Application of Methods for Relating NFDRS and Fire Activity," between the USDA, Forest Service, Intermountain Research Station and Systems for Environmental Management.

This research was supported in part by funds provided the U. S. Department of Agriculture, Forest Service, Intermountain Station, Ogden, Utah. Additional funding was provided by Systems for Environmental Management, Missoula, Montana.

Background

Cooperative aid research agreements INT-87228 and INT-88296 between Systems for Environmental Management (Dr. Don Loftsgaarden, principal investigator) and the Intermountain Research Station explored relationships between fire danger rating indexes and fire occurrence.

Logistic models for predicting the probability of at least one fire (on a given day) as a function of one or more danger rating indexes were developed at both forest and district levels using fire weather and fire occurrence records from the Lolo National Forest (Loftsgaarden, 1987). The logistic model is of the form:

$$P(FD|x) = 1./(1. + \exp(-\beta_1 - \beta_2 * x))$$

where P(FD|x) the probability of a fire day (given x), x is the value of the fire danger rating index, and β_1 and β_2 are the models intercept and slope. When P(FD) is plotted against the range of x values, a typical logistic probability curve is generated as shown in figure 1.

The initial agreement also explored methods of predicting 0, 1, 2, . . . or n fires per day and methods of scoring model accuracy.

The second agreement expanded the scope of logistic model development by using several fuel models and a second geographic area-- the National Forests of Mississippi (Loftsgaarden, 1988). This provided a basis of comparing and scoring the performance of several models on the same area-- a primary requirement of applying logistical models to fire business problems. Much effort was spent on that problem (scoring) with only partial success (Loftsgaarden, 1988). Three methods of scoring models were evaluated. However, an acceptable method had not been developed at the initiation of this study (1988).

Several menu driven computer programs were developed (during agreement INT-88296) to access the remote databases required to generate logistic models (Bradshaw, 1988). Although developed exclusively for this research effort and currently restricted to the IFSL-Data General configuration, they perform functions useful to the general fire danger rating community.

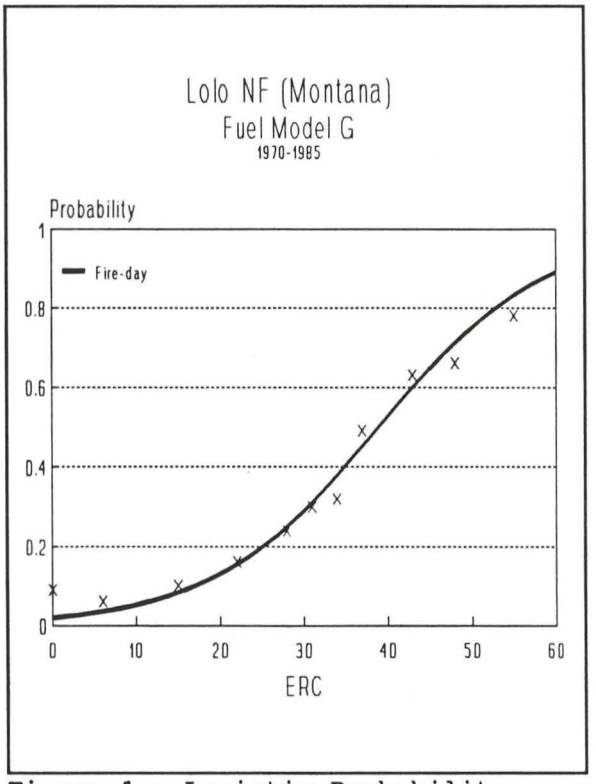


Figure 1. Logistic Probability Curve

Objectives

The general objective of this current research effort has been to develop and apply logistic fire occurrence models on a range of fire danger/fire activity relationship problems. The study proceeded in four phases over two years.

Phase 1 had five specific objectives:

1. Determine whether the methods can be used to choose the "best" fuel model and index.

2. Compare the performance of the NFDRS as revised for the Eastern U.S. to the currently used 1978 NFDRS.

3. Use the methods (objective 1) to assess the adequacy of various weather options for calculating NFDRS indexes.

4. Refine methods of setting classes (manning) based on an NFDRS index.

5. Based on the experience and success of working on objectives 1 through 4, recommend the design of a system to be used by fire managers to incorporate logistic models into their fire management tasks.

Phase 2 added four more objectives:

6. Continue comparison of the 78 and 88 NFDRS for 2 Forests in Mississippi and draft a paper for the Southern Journal of Applied Forestry.

7. Continue work with methods of setting classes and look at other indicators (large fire day, multiple fire day, etc.).

8. Develop interactive graphics to guide fire managers in setting decision classes. Develop a presentation for the 1989 NFDRS course at the National Advanced Resource Technology Center.

9. Apply methods of setting levels to the 11 Region 1 map areas and draft a General technical report.

Phase 3 added four additional objectives:

10. Expand the R1 NFDRS map work to include analysis of a large-fire-day and of a multiple-fire-day, and percentiles for all-days, fire-days, large-fire-days, and multiple-fire-days.

11. Apply methods for setting decision levels that were developed for the Lolo NF to the Stanislaus NF in California and Black Creek NF in Mississippi.

12. Analyze the relationship between fire history and NFDRS indexes for Southern Forests other than Black Creek. Prepare graphics to be use in a presentation to the Region 8 Fire Management Officers.

13. Refine and expand procedures for accessing data bases at FCCC so that it will work with computers other than the IFSL-DG, and allow NFDRS calculations to be done at FCCC instead of a host DG.

Phase 4 added three final objectives:

14. Examine the work in progress by a student in the University of Montana mathematics department on conditional probability of large-fire days. Determine if these methods can be used with, or instead of our current methodology.

15. Examine the implications of using a limited fire weather and fire history data set as might be true for a single National Park. Define minimal data standards.

16. Work with RWU 4401 to assess how this work might fit into a future integrated fire behavior/fire danger rating system. Determine if and how this work might be used as a transition from the current to future systems.

Executive Summary

The initial work on the phase 1 objectives coincided with additional work by Dr. Loftsgaarden in determining methods for comparing and evaluating models. In essence, we used the first three objectives to provide many models (hundreds) from the same and different data sets, and worked interactively with Dr. Loftsgaarden in comparing them. A complete discussion the generation, use, and comparison of logistic regression models--and their application to fire business problems is reported by Loftsgaarden and Andrews (in preparation). The process of generating, evaluating, and comparing these many models took most of the time allocated to phase one of this study. In fact it was not until late in the study when an objective, statistically defensible methodology for comparing models (objective 1) was established. As such, only minor efforts were afforded to objectives 4 and 5 in phase 1.

Phase 2 of the study was highly successful in both the work done and reception to presentations at the 1989 NFDRS course. The only substantial snag in phase 2 were problems encountered in comparing the 1978 and 1988 NFDRS systems. The methodology for comparing and evaluating the two systems developed in phase 1 is satisfactory. Yet, operational problems in the FIREFAMILY programs and historical data requirements for the 1988 system forced postponement of objective 6.

We made substantial progress in evaluating alternate fire business indicators (large fire day, multiple fire day, etc.), and establishing a process for setting fire danger class intervals based on fire business information, not just fire weather (danger). Much of this success was a result of much interaction with the Lolo National Forest in helping them establish critical values for their action plan currently in development. The process is not cookbook--it requires professional judgement and interactive processes.

We developed two, 2-hour presentations for the 1989 NFDRS course (December 4-14) at the National Advance Resource Technology Center (NARTC), Marana, Arizona, and received extremely positive feedback from most of the participants. A typical comment was "This has more practical application to the field units than any other aspect covered this week." The two 1989 presentation were combined into a single 2-hour presentation at the 1990 NFDRS course (NARTC, December 1990). Again, most comments perceived the usefulness of having objective methods for comparing NFDRS index performance and relating NFDRS indexes to fire activity.

Finally in phase 2, we generated logistical models for the eleven Region 1 fire danger rating polygons, and compared the current parameters used for setting adjective classes (low, medium, high, etc . . .) against the fire business curves. The results followed what we found in our earlier work with the Lolo and Custer Forests. The methods work well for west side forests/polygons with a fire incidence of above 30 percent. East side forests/polygons with lower fire incidence (15-20 percent) had less favorable results.

In phase 3 we added large-fire days (10+ acres) and multiple-fire days (5 or more) to the polygon analysis. The region 1 polygon work is currently being compiled into a General Technical Report (Bradshaw and Andrews, in preparation) and is summarized later in this report.

Additionally in this phase we worked up a fire business analysis for Gary Biehls (Fire Management Officer, Stanislaus National Forest, California) using NFDRS indexes from the Mt. Elizabeth data set. Mr. Biehls used the information for an "All Risk Management" study on the

Stanislaus and was helpful in setting levels (based on ERC and BI) for implementing forest restrictions in the Stanislaus. Also, we prepared a presentation for Forest Service Fire Management Staff Officers in Region 8 which was given by Pat Andrews in Little Rock, Arkansas, February 1990.

Finally in phase 3 we developed FCFAST (Fort Collins Fire Access Software) that provides a user-friendly front end to the fire business related databases and software currently housed at the Fort Collins Computer Center. FCFAST was written for both Forest Service (via Data General) access, and non-Forest Service (via Personal Computer) access to FCCC. FCFAST started as a generalization of the in-house programs developed under agreement INT 88296 for access to FCCC. With appetites whetted from the obvious utility of FCFAST, testers wanted more and more features.

FCFAST underwent six-months of general testing, with a final test application at the 1990 NFDRS training course (NARTC, December 1990). Twenty-seven DG users did in one three-hour lab what the 1989 NFDRS course barely completed in three, four-hour labs. Also, eighteen PC users accessed weather data from FCCC--something they could not even do in 1989. Integration of FCFAST into the 1990 NFDRS course was a complete and overwhelming success.

The extensive testing and considerable utility of FCFAST resulted in a more comprehensive FCFAST than initially intended, with prolonged development time. However, it was time well spent. With the current conversion of NCC-FC from Univac to IBM, future data requests can be through the same front end--FCFAST (which will require slight modification to perform its tasks on the IBM). Without FCFAST, hundreds of people would need to learn the IBM operating system **and** new commands to extract data from the fire business libraries.

The USDA, Forest Service, Washington Office of Aviation and Fire Management adopted FCFAST as National System and released it through both the Software Reference Center and Forest Resources Systems Institute (FORS). An upcoming issue of Fire Management Notes describes FCFAST (Bradshaw and Andrews, 1991). Appendix A contains a draft of this paper, the FCFAST documentation/maintenance manual, and program user notes.

Much of the time allocated to the final phase of the study was consumed preparing FCFAST for National System status and its integration into the 1990 NFDRS course at NARTC. As such, less time was spent on objectives 14 and 15 than anticipated.

As the work reported here concludes, we are prepared to recommend a system design that will allow fire managers to incorporate logistic models into their fire management tasks. We have had many, many requests from fire managers to perform an analysis for specific areas and problems (Forest Service, BLM, and NPS). Getting a system available for distribution has become a priority. The design of this system and its role in the integrated fire behavior/fire danger rating system under development by RWU 4401, is addressed in a combined discussion of objectives 5 and 16. Figure 2 describes the general flow of information within the system, which we have called FIRES.

FCFAST performs the tasks of extracting historical weather, fire danger rating indexes, and fire occurrence data. WIMS (Weather Information Management System, in development) will provide current season weather for past to current comparisons. NFDRS-FIRDAT can be either the 1978, 1988, or the next generation fire danger rating processor.

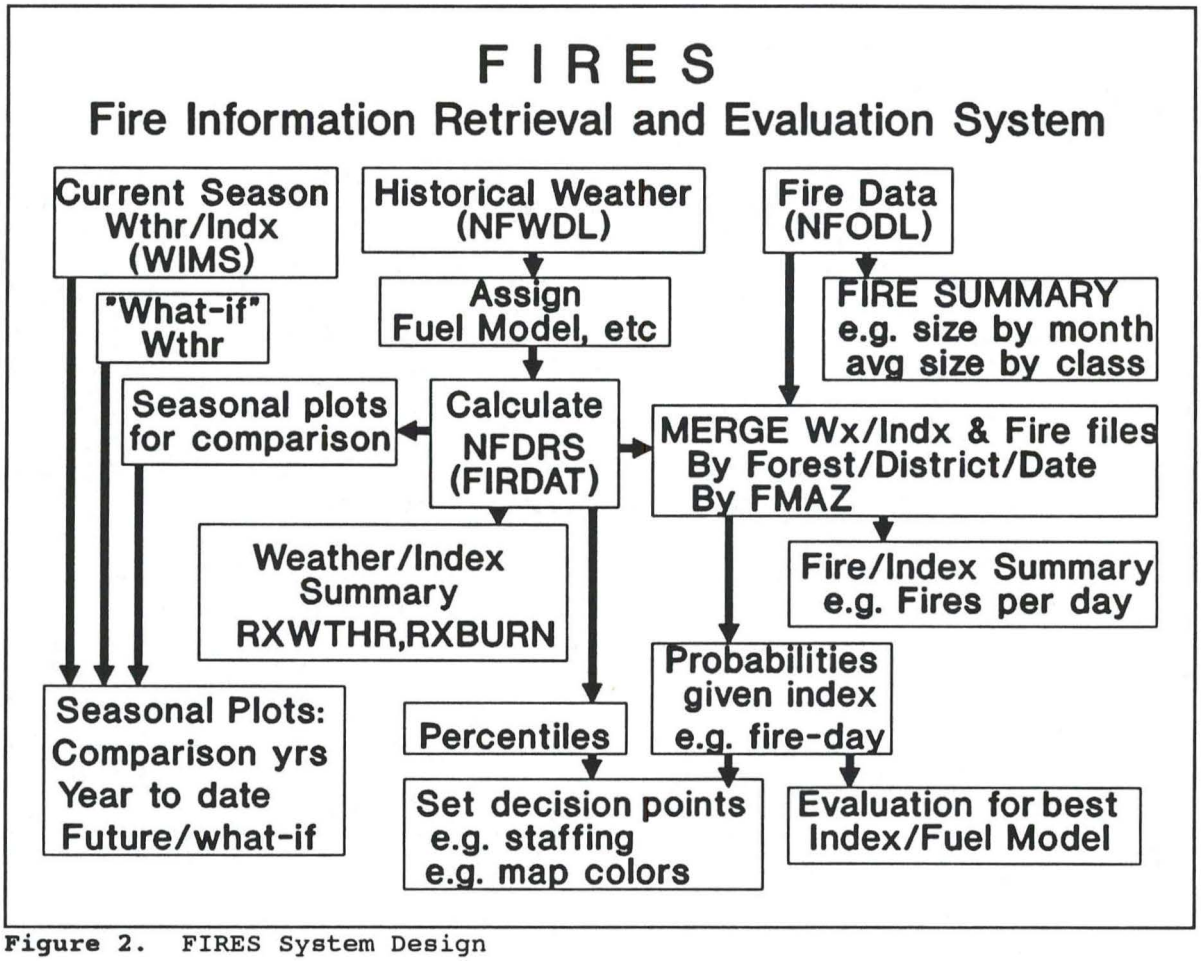

F I R E S
Fire Information Retrieval and Evaluation System
Current Season Wthr/Indx (WIMS)
Historical Weather (NFWDL)
Fire Data (NFODL)
"What-if" Wthr
Assign Fuel Model, etc
FIRE SUMMARY e.g. size by month avg size by class
Seasonal plots for comparison
Calculate NFDRS (FIRDAT)
MERGE Wx/Indx & Fire files By Forest/District/Date By FMAZ
Weather/Index Summary RXWTHR,RXBURN
Fire/Index Summary e.g. Fires per day
Probabilities given index e.g. fire-day
Seasonal Plots: Comparison yrs Year to date Future/what-if
Percentiles
Set decision points e.g. staffing e.g. map colors
Evaluation for best Index/Fuel Model

Figure 2. FIRES System Design

FIRES will provide the framework to perform the tasks required for merging and analyzing index and fire files, generating fire-day probability functions, and fire-day cumulative distributions. It also will provide guidance in setting decision points and comparing the "fire business" value of different indexes.

Objective 1. Choosing the "best" fuel model/index

The paramount goal of this study was to determine if logistical models could be used to find the "best" fuel model/fire danger rating index combination for a particular fire business problem. Much effort was spent on this problem in conjunction with Dr. Loftsgaarden. The process required development of a semi-automated process for generating the logistic models required for each study area. Work in the previous agreements was based on a few models at each study area, while this study required a **minimum** of 100 models (5 indexes for 20 NFDRS fuel models per weather station)for each study area. We used the following study areas:

1. Lolo National Forest, Montana (By District)

Station	Years	Season	Days	Fire Days
Missoula	70-85	05/01-10/31	2442	294
Ninemile	70-85	05/01-10/31	2442	294
Plains	70-85	05/01-10/31	2444	180
Superior	70-85	05/01-10/31	2328	301
Seeley Lake	70-85	05/01-10/31	1607	177
Thompson Falls	70-85	05/01-10/31	1547	125

Lolo National Forest, Montana (All Districts)

Station	Years	Season	Days	Fire Days
Missoula	70-85	05/01-10/31	2502	899

2. Custer National Forest, Montana (All Districts)

Station	Years	Season	Days	Fire Days
Ft. Howes	70-88	05/01-10/31	2539	500

3. Stanislaus National Forest, California (All Districts)

Station	Years	Season	Days	Fire Days
Mt. Elizabeth	72-88	05/01-10/31	2314	837
Mt. Elizabeth	78-86	05/01-10/31	1304	466
Pine Crest	70-88	05/01-10/31	2609	924
Groveland	70-88	01/01-12/31	3756	948
Groveland	70-88	05/01-10/31	2767	948

4. National Forests of Mississippi (Bude & Black Creek Districts)

Station	Years	Season	Days	Fire Days
Bude	73-87	01/01-12/31	5252	160
Black Creek	74-87	01/01-12/31	3711	924

5. Region 1 (All Forests and districts) by map polygons.

Map Polygon	NWS Zone(s)	Weather Station(s)	Years	Season	Total Days	Fire Days
1	101	Priest Lake Libby Trout Cr	70-88	04/01-10/31	3477	1470
2	102	Potlatch Kelly RS Powell RS	70-88	05/01-10/31	3179	1002
3	103	Moose Cr West Fork RRAWS	70-88	05/01-10/31	3381	1175
4	104	West Glacier Spotted Bear Plains	70-88	05/01-10/31	3108	1030
5	105	Condon Stevensville	70-88	05/01-10/31	3053	864
6	106 110	Helena Phillipsberg White Sulfur	70-88	05/01-10/31	3039	855
7	107	Wise River Ennis	70-88	05/01-10/31	3102	308
8	108	St. Mary Gleason	70-88	05/01-10/31	2182	82
9	111	Squaw Hebgen Lk Redlodge	70-88	05/01-10/31	3187	498
10	109 112 114	Rocky Boy Sawmill Cr Knowlton Bluff Ervin	70-88	05/01-10/31	1616	25
11	113 115 116	Custer Batt Ft. Howes Camp Crook	70-88	05/01-10/31	3099	461

Generation of Logistic Models

Generation and comparison of logistic models is a multi-step process (figure 3) for each study area, and requires a fairly complex software infrastructure. Weather and fire occurrence data fetches use software developed in INT-88296 to access and prepare data files for the analysis. Model development and comparision is facilitated by a linked series of SAS procedures and FORTRAN programs developed under the current agreement. The SAS procedures perform most of the data management and manipulation. The FORTRAN programs read SAS output files and 1) perform some housekeeping for the goodness of fit analysis, and 2) set up new SAS procedures based on the current analysis area and design. The interfacing of the SAS procedures with the FORTRAN programs automates laborious steps from previous agreements.

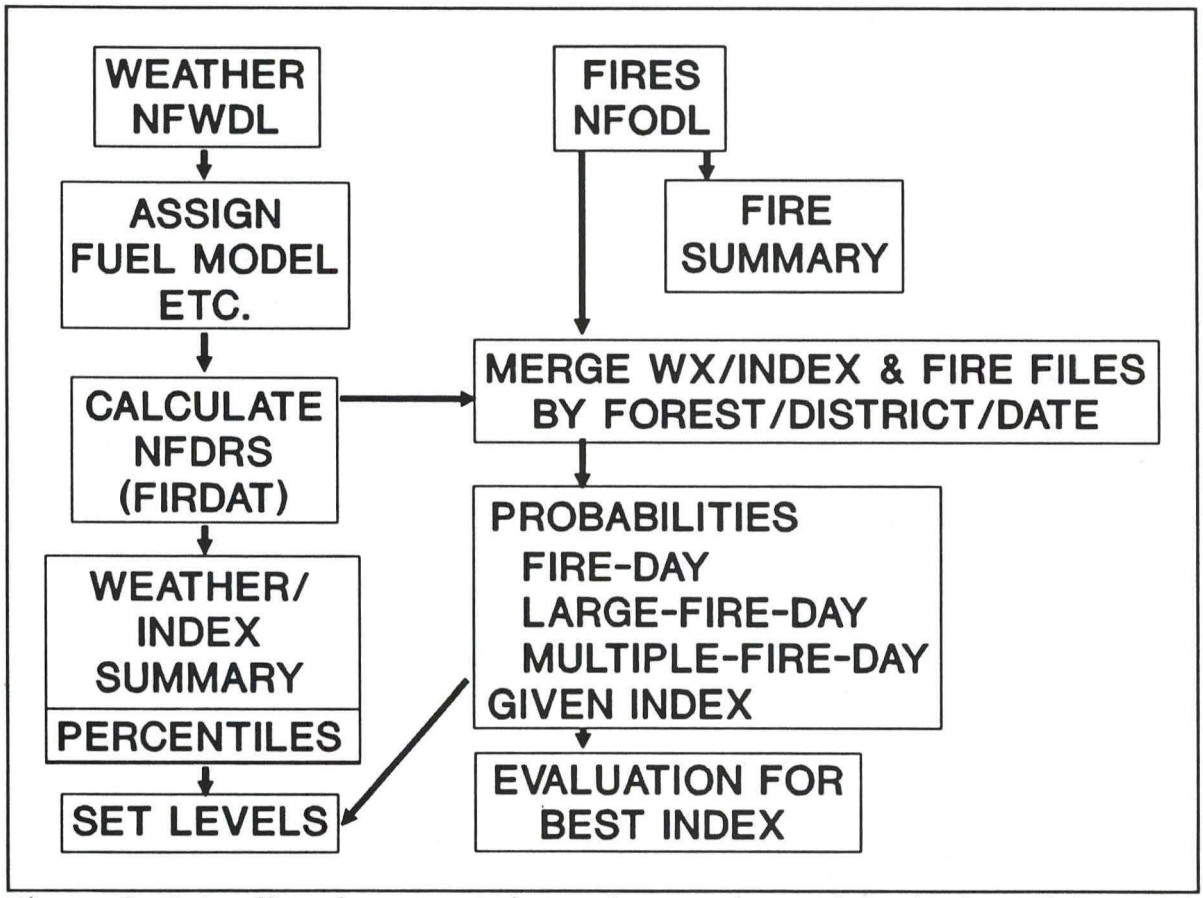


Figure 3. Data flow for generation and comparison of logistic models

The following definitions are useful in understanding an analysis process.

Analysis Area

When an analysis area is defined a 6 character or less key is assigned to the area. All subsequent files relating to this area then begin with that key. In the following discussion, AREA refers to this key.

Dependent Variables

The SAS AGGREGATE procedure generates the following dichotomas variables for **each day** there is a weather observation and combines them with the days index/weather variables:

FIREDAY : 0 = no fire this day, 1 = 1 or more
LARFIRE : 0 = no large fires, 1 = 1 or more
LFIRE : 0 = no lightning fires, 1 = 1 or more
LLFIRE : 0 = no large lightning fires, 1 = 1 or more
MFIRE : 0 = no human fires, 1 = 1 or more
LMFIRE : 0 = no large human fires, 1 = 1 or more
THREE : 0 = less than three fires this day, 1 = three or more
FIVE : 0 = less than five fires this day, 1 = five or more
TEN : 0 = less than ten fires this day, 1 = ten or more

plus these ordinal values:

FIRES : Total number fires this day
LFIRES : Total number lightning fires this day
MFIRES : Total number human fires this day

Pre-SAS Data Files

The value WX in a file name refers to weather files, FIRE is for fire files, and INDEX is for weather/danger rating index files. The term 'FILLED' in any file name signifies the file has been filled for missing data. Thus, if an analysis area has the key "CUSTER", the file CUSTER_-FILLED_INDEX would be the filled index file for the Custer analysis area.

SAS Files

Several SAS template files provide a skeleton structure for all the SAS procedures in an analysis. Initially they define an analysis for 20 fuels models and five NFDRS indexes. They are modified as needed for an area analysis and saved using the naming convention described above. The analysis part of the process uses four basic file types. They are:

INDEX: Weather/index file for an analysis area.
FIRE : All fire records for an analysis area.
MERGE: A merged (by date) file of the INDEX and FIRE files.
ANAL : A analysis file created by aggregating all the fires by date into a series of dichotomous and cardinal variables that fully define the fire business on a given day.

All files that end with '.SAS' are SAS command files. All SAS command files should begin with an area key, and contain one of the following middle phrases:

AGGRE: Aggregate command file
BUILD: Build command file (generates WX, FIRE, and MERGE files)
CROSS: Cross tabulation frequency command file
FDSUM: Fire-Day tabulation command file
FISUM: Fire Occurrence tabulation command file

MODEL: Logistic model generator command file
UNIVA: Univariate procedure command file
WXSUM: Weather summary command file

For example the file 'CUSTER_AGGRE.SAS' is the SAS command file for the aggregate run for the CUSTER analysis area.

Other SAS file naming conventions

All files that end with '.SSD' are SAS system data files.
All files that end with '.LOG' are SAS command LOG files.
All files that end with '.LIS' are SAS output list files.
All files that end with '.OUT' are batch SAS output files.

SAS Template Files

All files that begin with 'SAS_' and end with '_TPLATE' are SAS template files and have a middle phrase that contains one of the SAS type phases listed above. For example, the file 'SAS_MODEL_TPLATE' is the template file for the logistic model SAS programs. To create a SAS command file from a SAS template file, copy the template file into a new command file shell. For example, to create a MODEL.SAS file for LOLO, use the copy command:

copy/d LOLO_MODEL.SAS SAS_MODEL_TPLATE

and then edit LOLO_MODEL.SAS to contain the correct file and variable names.

The SAS template files and their functions are:

1. SAS_BUILD_TPLATE

Reads 1) fire danger index file, and 2) fire occurrence file and creates two SAS system data files. The fire danger (INDEX) and occurrence (FIRE) system files are then merged into the MERGE file. The MERGE file is ordered by year, month, day and weather station number, and contains at least one weather record **and** one fire record for every day within the fire season, for every year in the analysis. (Remember, no-fire day records were created in the fill process.) Many dates will have one weather record and multiple fire records.

The INDEX template is set for up a 20 fuel model/5 index analysis. Fuel models are ordered from MOD_1 to MOD_20. The merge file also contains the observed weather parameters (temperature, wind speed, humidity, precipitation, etc.). The variable MISSDAY controls the maximum length of a string of interpolated weather. (Default is 7.)

The FIRE template requires a new variable, STATNO that defines which weather station a set of fire occurrence data is assigned to. STATNO is defined by the user in the SAS procedure to the STATNO of the weather station.

2. SAS_AGGRE_TPLATE

This file provides a skeleton SAS procedure for processing the MERGE file into an analysis (ANAL) file that contains one record for every day of weather. The analysis file contains the date, weather station, all the weather and index values, and several computed "fire business" variables (fire day, large fire day, multiple fire day, number of fire, number of large fires, etc.).

3. SAS_FISUM_TPLATE

This file provides a skeleton SAS procedure for basic fire occurrence cross tabulations that are **independent** of the INDEX file and use either the MERGE or FIRE file created by the BUILD procedure. Summaries generated include fires by district by year, month, size class, and cause.

4. SAS_WXSUM_TPLATE

This SAS file template provides a skeleton SAS procedure for basic INDEX file summaries. It tabulates the number of days of weather by year and month. It also generates any number of frequency distributions and descriptive statistic summaries for any of the INDEX file variables.

5. SAS_MODEL_TPLATE

This SAS template provides a skeleton SAS procedure for generating logistic models from the analysis (ANAL) file. It uses the SAS procedure CATMOD and defines the index variable as the independent variable and models the response variable. The response variable is one of the dichotomous fire business variables generated by the aggregate step. It is initially structured to build models for all of the indexes (IC, SC, ERC, BI, FLI) for each fuel model in the analysis file.

Before the CATMOD procedure is started, the FREQ procedure is run on the response variable(s). The list file (.LIS) is read by the FORTRAN program EFRON to generate the first cut model performance summary information (Sum of squares and Efron's R^2).

6. SAS_UNIVA_TPLATE

In order to compare the model (which is based on the raw data) to the "best" predictor (the data), the data must be grouped in some manner. In the first studies, grouping was done subjectively by Dr. Loftsgaarden with an eye for the number of groups (8-12) and an approximately equal number of observations in each group. For the quantity of models we were looking at, the subjective method was impractical. We used the SAS UNIVARIATE procedure to define index values at 10 percentile levels (0, 5th, 10th, 25th, 50th, 80th, 90th, 95th, 99th, and 100th) and linear interpolation to compute index values at the 37th and 67th percentiles. This gives 12 intervals for any index (distributions of indexes with many zeros may have less than 12 intervals) and provides a systematic basis for computing the **observed** fraction of fire-days/no fire-days in the model summary table.

The list (.LIS) file from the UNIVARIATE procedure is read by the NTILES (FORTRAN) program. The values at the 12 percentile levels define the intervals required for the chi-square and "best model" tests described in the following **Comparing Models** section. They

are also used to tabulate observed fire-days by index interval, where fire-day is any one of the dichotomous fire business variables. NTILES produces two SAS procedure files from the from information on the UNIVA list file:

AREA_CROSS.SAS

A cross tabulation of response variable (fire-day, large-fire day, etc.) by index class. The list (.LIS) file from this procedure is read by the CHISQ (chi square) FORTRAN program and defines the "observed" cells in the chi-square goodness of fit analysis table.

AREA_FDSUM.SAS

Performs basic fire-day summaries on the analysis file using intervals defined by the UNIVA and NTILE processes. These summaries are more extensive than those produced in the AREA_CROSS procedure and also include some "numbers of fires per day" by interval summaries.

The following section describes the three FORTRAN programs (EFRON, NTILES, and CHISQ) developed for the SAS/FORTRAN interface in a fire business analysis.

PROGRAM EFRON

FUNCTION: Computes EFRON's R^2 statistic for logistical models. The EFRON program interprets the list file from an 'AREA_MODEL.SAS' run and computes EFRONS's R^2 value for each model generated by the run. It determines the dependent variable from a command line arguement.

LOCATION: :D2:STAFF:FB:LOFTS:FOLDER5:

USAGE: X EFRON AREA_MODEL.LIS VARIABLE

where AREA_MODEL.LIS is the list file from the SAS AREA_MODEL run and VARIABLE is the dependent variable. (FIREDAY, LFIREDAY, THREE, FIVE, or TEN).

OUTPUT:

1. EFRON R^2 summary file. File name = AREA_MODEL.LIS.SUM

   a. Run summary: SS-total, fire days, total days
   b. Model summary: residual SS, efrons R^2, populations, model parameters, chisq (prob).
   c. Run Recap: model, parameters, ss-res, R^2

2. AREA_MODEL_PARMS (model parameter file) for use in chi-square runs. It contains sequential model number, parameter, coefficient, and intercept for each model.

MAINTENANCE:

SOURCE:	EFRON.F77
COMPILE:	F77 EFRON
LINK:	F77LINK EFRON F77GENERAL_ROUTINES.LB
EXTERNAL:	GETARG()

PROGRAM NTILES

FUNCTION: Generates a SAS command file for cross tabulation of FIREDAY by index value percentile range. NTILES scans a SAS UNIVARIATE list file to determine index values that approximate the 0, 5th, 10th, 25th, 50th, 75th, 90th, 95th, 99th, and 100th percentile levels. Uses linear interpolation to compute 37th and 62nd levels.

LOCATION: :D2:STAFF:FB:LOFTS:FOLDER5:

USAGE: X NITLES 'file'
where 'file' is the univariate list file: AREA_UNIVA.LIS

OUTPUT: SAS command files: AREA_CROSS.SAS, AREA_FDSUM.SAS

MAINTENANCE:
SOURCE: NTILES.F77
COMPILE: F77 NITLES
LINK: F77LINK NITLES F77GENERAL_ROUTINES.LB
EXTERNAL: GETARG()

PROGRAM CHISQ

FUNCTION: Generates Chi-square goodness-of-fit tables. Interprets output from 'AREA_-CROSS.LIS' files and compares observed versus expected frequency of fire days for index ranges defined by the UNIVARIATE and NTILES processes. Expected frequencies are computed from the logistic model using the class midpoint of each index interval. CHISQ gets model parameters from the 'AREA_MODEL_-PARMS' file generated by the EFRON program.

LOCATION: :D2:STAFF:FB:LOFTS:FOLDER5:

USAGE: X CHISQ AREA_CROSS.LIS AREA_MODEL_PARMS AREA_MODEL_PARMS

OUTPUT:
1. One chi-square table for each selected independent variable to file 'AREA_-CHISQ'
2. One set of plotting information to file: 'AREA_PLOT'

INPUT: CHISQ requires three (3) external input files:

1. AREA_CROSS.LIS: List file from AREA_CROSS.SAS run.
2. AREA_MODEL_PARMS: AREA_MODEL_PARMS file from EFRON run.
3. AREA_MODELS_LOOK: List of models to run chi-square analysis on. (Usually = AREA_MODEL_PARMS)

MAINTENANCE:
SOURCE: CHISQ.F77
COMPILE: F77 CHISQ
LINK: F77LINK CHISQ F77GENERAL_ROUTINES.LB
EXTERNAL: GETARG()

Other Fire Business File Naming Conventions

All files ending with '.F77' are fortran source code files.
All files ending with '.PR' are executable program files.
All files ending with '.CLI' are CLI macro files.

Files of the format 'AREA_MODEL_PARMS' contain logistic model parameters for an analysis area.

CLI Files

The macro file, GO.CLI is used to submit SAS runs in a batch mode:

USAGE: GO 'file'

where file is of the form AREA_PHRASE[.SAS] [=optional]

The macro file, START.CLI is used to submit an entire runstream for batch processing.

USAGE: START 'file'

where 'file' is a file containing a series of CLI commands. Often this file is the form of AREA_RUN and will contain the entire sequence of model developement to summary commands. For example, to perform a complete AREA analysis (after the FILLED INDEX and FIRE files are ready), an AREA_RUN file could contain these commands:

```
SAS AREA_BUILD
SAS AREA_AGGRE
SAS AREA_MODEL
X EFRON AREA_MODEL.LIS
SAS AREA_UNIVA
X NTILES AREA_UNIVA.LIS
SAS AREA_CROSS
X CHISQ AREA_CROSS.LIS AREA_MODEL_PARMS AREA_MODEL_PARMS
```

Comparing Models

A complete technical discussion of comparing models given by Loftsgaarden and Andrews (in preparation) and is briefly summarized here. There is a dual basis for comparing models and all the information required is available from the model summary table (program CHISQ) which generates a table similar to table 1 for each logistic model in an analysis. The data for this example are from the Lolo National Forest in Montana, Energy Release Component (ERC), fuel model G for the years 1970-1985. For the summary table, index (ERC) values are grouped into intervals and the logistic model uses the

Table 1. Lolo ERC, Fuel Model G, 1970-1985

Model: P(FD|ERC) = 1./(1. + exp(-.09999*ERC + 3.8902))								
			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Number
0	0-0	11	1	.09	.02	0	10	11
5	1-12	126	8	.06	.04	5	118	121
10	13-17	119	12	.10	.09	11	107	108
25	18-26	442	71	.16	.16	71	371	371
37	27-29	278	68	.25	.26	71	210	206
50	30-32	306	91	.30	.31	96	215	210
67	33-35	300	96	.32	.38	114	204	186
80	36-39	321	156	.49	.46	148	165	173
90	40-45	379	240	.63	.58	221	139	158
95	46-49	119	78	.66	.69	83	41	37
99	50-54	77	58	.75	.78	60	19	17
100	55-59	23	20	.87	.85	20	3	3
	TOTALS	2501	899			899	1602	1602
Chi Square: 16.05 D.F. = 9 Prob (0.0659)								
Model SS : SSTOT= 3266.83 SSR= 2809.02 R^2 = 0.14								
Grouped SS: SSTOT= 3266.83 SSR= 2791.63 R^2 = 0.14								
Difference = 17.36								

interval midpoint to compute the predicted fraction, and number of fire days in the interval. This data set contains 2501 days, 899 fire days, and 1602 no-fire days. The logistic model for Lolo (ERC-G) is:

$$P(FD|ERC) = 1./(1. + \exp(-.09999*ERC + 3.8902)).$$

The number of expected fire days is the product of expected fraction and total days in the interval.

Model evaluation and comparison is based on:

1. Comparing the residual sum of squares (SSR) between a model's predictions to the "best predictor" (which is the data itself), and

2. A chi square (goodness-of-fit) statistic computed from the expected versus observed fire day and no-fire day columns of table 1 over all index intervals.

We refer to the "best predictor" as the "grouped data" and the model predictions as the "raw data" or model predictions.

The total sum of squares (SSTOT) is the same for both grouped and raw data sets and is given by

$$SSTOT = -2*[FD*\ln(FD/TD) + NFD*\ln(NFD/TD)]$$

where FD is the number of fire days, NFD is the number of no fire days, and TD is the total number of days.

For this example, $SSTOT = -2*[899*\ln(899/2501) + 1602*\ln(1602/2501)] = 3266.82$

SAS provides the sum of squares explained (SSE) and residual (SSR) and for each logistic model. In this example they are 2890.81 and 457.81, respectively. The classic R^2 defined by SSR/SSTOT is 0.14. SSE and SSR for the grouped data are computed and summed for all intervals in table 1 using the **observed** fractions of fire days and no-fire days in the interval. In this example they are 2791.63 and 475.20, respectively.

The first comparison is the difference between the raw (model) SSE and the data (grouped) SSE. This value is shown in table 1 (2809.02-2791.63 = 17.36). What this means is that the **best** the **model** could have done was to reduce the SSE another 17.36. One can conclude the model fits the data very well as the grouped data ("best predictor") explains very little additional variation over the logistic model. As a general rule, the smaller the improvement of the data over the model, the better the model. The ANOVA table for this example is given in table 2.

Table 2. ANOVA Table for Sum of Squares, Lolo ERC (G)

Source	Deg. Freedom	Sum Squares	P-Value
Logistic Model (raw data)	1	457.81	.0000
Best over logistic	10	17.36	.0668
Residual	2489	2791.66	
Total	2500	3266.83	

The second comparison is based on a chi square goodness-of-fit statistic produced from table 1 by comparing expected versus observed fire days and no-fire days all the index intervals. In this case, the chi square value is 16.05 with 9 degrees of freedom, and P-value (probability of a larger chi square) = .0659.

Consideration of both parameters allows us two rules of thumb for comparing logistic models:

1. Models with lower differences in SSE between the model and the "best predictor" are better models, and

2. Models with lower chi square statistics (normalized by degrees of freedom) are better models.

Beyond these model to model comparisons, there are a few general characteristics of "good" logistic models.

1. The model should "score" well in the above tests. Chi square values below 10 (7 or 8 degrees of freedom) indicate good models. Improvements of SSE for grouped data over the model on the order of 30 or less are also indicated good models. In terms of scoring these guidelines may be used:

Model Class	Chi Square	SS Difference
Poor	>70	> 50
Good	20 - 70	20 - 50
Excellent	< 20	< 20

2. There should be a large range in the predicted fraction of fire days over the range of index values. In this example this value ranged from .1 at ERC=0 to .89 at ERC = 57. This property of logistic regression models is essential for predicting the probability of a fire day. For example, the Custer National Forest study area had **many** models that could be classified as "good" using the comparisons described above, but often had fire day probabilities that ranged only from 0.19 to .20 over the range of index values. Such a model, although fitting the data well, is basically useless.

Final Notes

The procedures here were developed so that a large number of logistic models (100 or more) could be constructed, evaluated, and compared quickly. To that end, the procedures have been used quite successfully. Other more sophisticated and "messier" tests of fit have been proposed recently. Most of these are not available in statistical computer packages and seem to be more appropriate when examining one model in detail.

Comparing the 1978 and 1988 versions of the NFDRS.

Recent changes made to the NFDRS have been incorporated into the 1988 release of the NFDRS which is currently undergoing operational testing (Burgan, 1988). One application of a fire business analysis is to determine how these changes effect the correlation of fire danger rating and fire occurrence. Part of the evaluation is subjective in that changes were made such that seasonal distributions of indexes "respond better", or "show less recovery after a rain." A need exists for objective methods to evaluate the changes. How do changes relate to expected fire activity?

The procedures described in objective 1 are directly applicable to this problem and the analysis is straight forward. You develop a fire business analysis on the same data (weather and fire) using both the 1978 and 1988 versions and compare the logistic models for goodness of fit.

This was done on two study areas on the National Forests of Mississippi. They were the Bude and Black Creek districts. The analysis was performed for three fuel models (C, G, and D) and five indexes (IC, SC, ERC, BI, and FLI). The 1988 version allows two processing options (1-h fuel moisture = 10-h fuel moisture, and 1-h fuel moisture $\neq$ 10-h). Both options were evaluated. A specific example is given here using data for Black Creek, fuel model C, Burning Index (n = 3711 days). Tables 3, 4, and 5 present the model summary information for 1978, 1988a (1-h = 10-h), and 1988b (1-h $\neq$ 10-h) and table 6 summarizes the model difference information.

Table 3. 1978 NFDRS Model Summary Table, BI(C) - Black Creek, MS

Model: P(FD|BI) = 1./(1.+exp(-0.0880* BI + 2.1073))								
			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Number
13	0-0	479	34	.07	.11	52	445	427
28	1-3	557	72	.13	.13	71	485	486
44	4-4	580	101	.17	.15	85	479	495
53	5-5	353	58	.16	.16	56	295	297
65	6-10	450	76	.17	.20	89	374	361
75	11-16	372	94	.25	.29	106	278	266
90	17-24	553	271	.49	.42	235	282	318
95	25-29	200	120	.60	.57	113	80	87
99	30-36	133	77	.58	.69	92	56	41
100	37-106	34	21	.62	.99	33	13	1
	TOTALS	3711	924			932	2787	2779
Chi Square: 193.34 D.F.=7 Prob (0.0000)								
Model SS : SSTOT= 4165.39 SSR= 3661.59 R^2 = 0.121								
Grouped SS: SSTOT= 4165.39 SSR= 3617.21 R^2 = 0.132								
Difference = 44.38								

Table 4. 1988a NFDRS Model Summary Table, BI(C), 1-h = 10-h (Black Ck)

Model: P(FD|BI) = 1./(1.+exp(-0.0981* BI + 2.1209))								
			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Num-ber
19	0-0	714	75	.11	.11	76	639	638
30	1-3	385	42	.11	.13	49	343	336
43	4-5	502	88	.18	.16	79	414	423
51	6-7	299	51	.17	.18	55	248	244
62	8-10	388	83	.21	.22	87	305	301
75	11-14	512	150	.29	.29	149	362	363
90	15-20	549	227	.41	.40	220	322	329
95	21-24	190	100	.53	.52	99	90	91
99	25-32	145	88	.61	.66	96	57	49
100	33-44	27	20	.74	.84	23	7	4
TOTALS		3711	924			933	2787	2778
Chi Square: 7.51 D.F. = 7 Prob (0.3778)								
Model SS : SSTOT = 4165.39 SSR = 3742.88 R^2 = 0.101								
Grouped SS: SSTOT = 4165.39 SSR = 3739.18 R^2 = 0.102								
Difference = 3.70								

Table 5. 1988b NFDRS Model Summary Table, BI(C), 1-h ≠ 10-h (Black Ck)

Model: P(FD|BI) = 1./(1.+exp(-0.1022* BI + 2.3363))								
			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Num-ber
17	0-0	636	56	.09	.09	56	580	580
26	1-3	326	26	.08	.11	35	300	291
43	4-6	620	89	.14	.14	86	531	534
53	7-9	399	78	.20	.18	72	321	327
65	10-12	426	104	.24	.23	98	322	328
77	13-16	434	110	.25	.30	130	324	304
90	17-23	511	232	.45	.43	218	279	293
96	24-28	193	117	.61	.58	112	76	81
99	29-36	133	86	.65	.73	97	47	36
100	37-44	33	26	.79	.86	28	7	5
TOTALS		3711	924			932	2787	2779
Chi Square: 15.76 D.F.=7 Prob (0.0375)								
Model SS : SSTOT= 4165.39 SSR= 3603.11 R^2 = 0.135								
Grouped SS: SSTOT= 4165.39 SSR= 3599.42 R^2 = 0.136								
Difference = 3.69								

Table 6. 1978 vs 1988 NFDRS Performance Consolidation

Model	Chi Square	Deg. Fre-edom	P-Value	Improvement of grouped over model
1978	193.34	7	.0000	44.38
1988a	7.51	7	.3778	3.70
1988b	15.76	7	.0375	3.69

Evaluation of table 6 shows that 1988a and 1988b are far better models than 1978 for this data set, and that 1988a is the best overall model as it had the lowest chi square value and a low improvement of grouped over raw. Figure 4 illustrates the logistic curves for this analysis for the 1978 and 1988a data sets. (1988b is essentially the same as 1988a.)

One thing immediately evident from figure 4 and tables 3, 4, and 5 is that the 1988

versions have lower ranges of BI (0-44) compared to the 1978 version (0-106). This results in **much** better fit of the model, particularly in the upper BI range. One of the specific 1988 revision objectives was to reduce the effect of wind after a frontal passage as the 1978 version tended to overrate fire danger under such conditions. In this capacity, the 1988 version shows a significant improvement over the 1978 version in correlation of fire danger to fire activity. Tables 7 and 8 summarize the 1978 versus 1988 performance for the data sets we worked with at Black Creek and Bude in the National Forests of Mississippi. The summary is based on a simple scoring technique that assigned (1) to the best model, (2) to the second best, and (3) to the model with the "worst" goodness of fit. The scores were then summed for all indexes (BI, SC, etc) for each fuel model and NFDRS system version. In addition, each model was given a subjective rating of excellent, good, or poor.

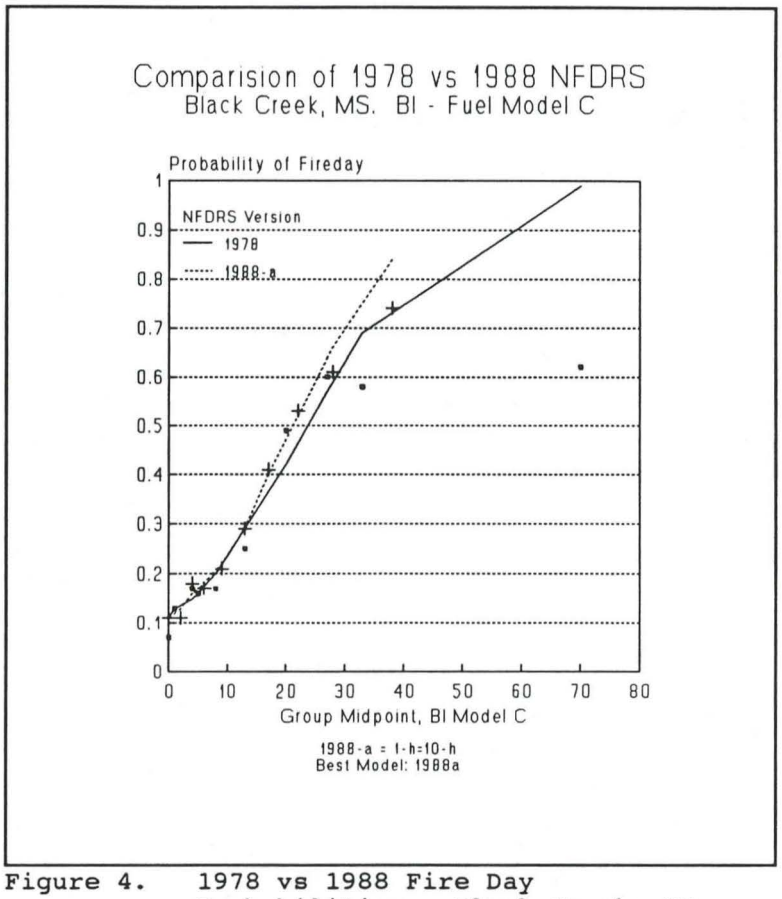


Figure 4. 1978 vs 1988 Fire Day Probabilities, Black Creek, MS.

As we prepared for a more complete analysis of various study areas, we ran into operational problems which made it unadvisable to continue analysis for a publication as originally planned. Although a good effort was made to make the two systems upwardly compatible, the 1988 version requires data not used by previous NFDRS versions, and thus, unavailable in the NFWDL at Fort Collins for generation of a historical climatology. These parameters are:

1. Entry of Greenness Factors,
2. Season (spring/summer/fall/winter), and
3. Use of Keetch Byram Index

Table 7. Summary of 1978 versus 1988 NFDRS (Black Creek Data Set)

Total Days: 3711
Fire Days : 924

Model Scoring: 1 = Best
2 = Middle
3 = Worst

Model Classification: E = Excellent
G = Good
P = Poor

System/Fuel Model/Option	Total	Index/Score/Class IC	SC	ERC	BI	FLI
1978 Model C	12	2 P	3 P	1 P	3 P	3 P
1988 Model C (1-h = 10-h)	9	3 P	1 P	3 P	1 E	1 E
1988 Model C (1-h ≠ 10-h)	9	1 P	2 P	2 P	2 E	2 E

System/Fuel Model/Option	Total	Index/Score/Class IC	SC	ERC	BI	FLI
1978 Model D	13	2 P	3 P	2 G	3 P	3 P
1988 Model D (1-h = 10-h)	10	3 P	1 P	3 P	1 G	2 G
1988 Model D (1-h ≠ 10-h)	7	1 G	2 P	1 G	2 G	1 G

System/Fuel Model/Option	Total	Index/Score/Class IC	SC	ERC	BI	FLI
1978 Model G	12	2 P	3 P	1 P	3 G	3 G
1988 Model G (1-h = 10-h)	12	3 P	2 P	3 P	2 E	2 G
1988 Model G (1-h ≠ 10-h)	6	1 G	1 P	2 P	1 E	1 E

Score Summary

NFDRS Version	C	D	G	Total
1978	12	+ 13	+ 12	= 37
1988 (1-h = 10-h)	9	+ 10	+ 12	= 31
1988 (1-h ≠ 10-h)	9	+ 7	+ 6	= 22 (Best overall scored)

Best overall model: C and G
Best overall index: BI

Table 8. Summary of 1978 versus 1988 NFDRS (Bude Data Set)

Total Days: 5252
Fire Days : 160

Model Scoring: 1 = Best
2 = Middle
3 = Worst

Model Classification: E = Excellent
G = Good
P = Poor

System/Fuel Model/Option	Total	Index/Score/Class IC	SC	ERC	BI	FLI
1978 Model C	9	1 P	1 P	1 G	3 P	3 G
1988 Model C (1-h = 10-h)	12	3 P	3 P	3 P	2 G	1 G
1988 Model C (1-h ≠ 10-h)	9	2 P	2 P	2 P	1 G	2 G

System/Fuel Model/Option	Total	Index/Score/Class IC	SC	ERC	BI	FLI
1978 Model D	11	2 P	1 P	2 P	1 G	3 P
1988 Model D (1-h = 10-h)	11	3 P	2 P	3 P	2 G	2 G
1988 Model D (1-h ≠ 10-h)	8	1 P	3 P	1 G	3 P	1 G

System/Fuel Model/Option	Total	Index/Score/Class IC	SC	ERC	BI	FLI
1978 Model G	10	1 G	2 P	1 P	3 P	3 G
1988 Model G (1-h = 10-h)	13	3 P	3 P	3 P	2 P	2 P
1988 Model G (1-h ≠ 10-h)	7	2 P	1 P	2 P	1 G	1 G

Score Summary

NFDRS Version	C	D	G	Total
1978	9	11	10	30
1988 (1-h = 10-h)	12	11	13	36
1988 (1-h ≠ 10-h)	9	8	7	24 (Best overall score)

Best overall model: C and D
Best overall index: FLI

Assessing various weather options for calculating NFDRS indices.

The techniques developed in objective 1 are appropriate for evaluating various weather options. Specifically, we can compare indexes from different weather stations on a single fire occurrence data set and determine the most appropriate weather station. Also, we could evaluate different sources of weather data (AFFIRMS, NOAA, etc.) for their appropriateness for use in fire danger rating.

We developed and analyzed logistic models based on weather stations and fire occurrence in two polygons (04 and 05) from data set 5 (page 8). We did an analysis (1000-h fuel moisture, and ERC and BI for fuel model G) for each station individually, and for the daily polygon average of the stations within each zone. Averaging was done through SAS programming. Operationally, the polygon average value is used for the region 1 polygon maps. Results are presented using ERC for polygon 4 which contains three stations:

1. West Glacier,
2. Spotted Bear, and
3. Plains.

Tables 9, 10, 11, and 12 contain the results for West Glacier, Spotted Bear, Plains, and the daily average of Polygon 4, respectively.

By comparision of the goodness of fit and differences in SSR's Spotted Bear appears to fit the data best. Looking at the columns containing observed fire-days and predicted fire-days, we see that the fit is particulary good at lower ERC levels where the other stations overpredict fire-days (except at ERC = 0). We also notice that Spotted Bear has almost 1000 less days of weather than the all station average data set and about 150 less fire-days.

Looking at the three station average and the Plains only data sets, which are very close in population size, we see that Plains has the lower chi square statistic, and also a slightly larger range of fire-day probabilities (.03 to .90 versus .04 to .85).

In this case it would be hard to definately say which is a more representative data set. But you could say with some certainty that using Plains only is not significantly worse than using data from Plains, Spotted Bear, and West Glacier combined.

Table 9. Goodness-of-fit summary for West Glacier, 1970-88

Model: P(FD|ERC) = 1./(1. + exp(-.08550* + 2.5008))								
Poly 04: West Glacier			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Number
0	0-0	40	7	.18	.08	3	33	37
5	1-5	59	7	.12	.10	6	52	53
10	6-9	112	8	.07	.13	15	104	97
25	10-16	265	46	.17	.20	53	219	212
37	17-20	228	74	.32	.29	65	154	163
50	21-24	275	99	.36	.36	99	176	176
67	25-27	218	91	.42	.43	94	127	124
80	29-31	222	111	.50	.51	112	111	110
90	32-37	257	173	.67	.61	157	84	100
95	38-41	84	48	.57	.71	59	36	25
99	42-50	73	56	.77	.81	59	17	14
100	51-59	15	13	.87	.90	14	2	1
	TOTALS	1848	733			736	1115	1112
Chi Square: 25.41 D.F. = 9 Prob (0.0050)								
Model SS : SSTOT= 2482.34 SSR= 2182.98 R^2 = 0.12								
Grouped SS: SSTOT= 2482.34 SSR= 2163.66 R^2 = 0.13								
Difference = 19.32								

Table 10. Goodness-of-fit summary for Spotted Bear, 1970-88

Model: P(FD|ERC) = 1./(1. + exp(-.0775 * + 2.3581))								
Poly 04: Spotted Bear			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Num-ber
0	0-0	55	6	.11	.09	5	49	50
5	1-4	61	4	.07	.10	6	57	55
10	5-10	121	18	.15	.14	18	103	103
25	11-18	357	89	.25	.23	80	268	277
37	19-22	263	76	.29	.32	83	187	180
50	23-26	302	125	.41	.39	117	177	185
67	27-29	252	108	.43	.45	114	144	138
80	30-33	223	118	.53	.52	116	105	107
90	34-40	303	187	.62	.62	189	116	114
95	41-43	90	70	.78	.71	64	20	26
99	44-48	83	58	.70	.77	64	25	19
100	49-52	18	12	.67	.83	15	6	3
	TOTALS	2128	871			871	1257	1257
Chi Square: 12.57 D.F. = 9 Prob (0.2500)								
Model SS : SSTOT = 2879.63 SSR = 2564.77 R^2 = 0.11								
Grouped SS: SSTOT = 2879.63 SSR = 2571.74 R^2 = 0.11								
Difference = -6.97								

Table 11. Goodness-of-fit summary for Plains, 1970-88

Model: P(FD|ERC) = 1./(1. + exp(-.07374* + 3.5799))								
Poly 04: Plains			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Number
0	0-0	14	2	.14	.03	0	12	14
5	1-15	147	7	.05	.05	7	140	140
10	16-20	174	8	.05	.10	17	166	157
25	21-28	427	54	.13	.15	62	373	365
37	29-32	372	72	.19	.21	78	300	294
50	33-37	457	143	.31	.27	123	314	334
67	38-41	326	122	.37	.34	110	204	216
80	42-46	382	152	.40	.42	159	230	204
90	47-56	458	257	.56	.55	254	201	204
95	57-62	137	96	.70	.69	95	41	42
99	63-74	118	83	.70	.81	96	35	22
100	75-83	28	24	.86	.90	25	4	3
	TOTALS	3040	1020			1020	2020	2014
Chi Square: 26.45 D.F. = 9 Prob (0.0050)								
Model SS : SSTOT = 3879.18 SSR = 3321.14 R^2 = 0.14								
Grouped SS: SSTOT = 3879.18 SSR = 3296.69 R^2 = 0.15								
Difference = 24.45								

Table 12. Goodness-of-fit summary for daily average, 1970-88

Model: P(FD|ERC) = 1./(1. + exp(-.08171* + 3.2515))								
Poly 04: All Stations			FIRE DAYS				NO FIRE	
NTILE	Value Range	Total Days	Obs. Number	Obs. Frac.	Pred. Fract.	Pred. Number	Obs. Number	Pred. Number
0	0-0	12	2	.17	.04	0	10	12
5	1-11	152	10	.07	.06	9	142	143
10	12-15	174	10	.06	.10	18	164	156
25	16-22	474	52	.11	.15	73	422	401
37	23-25	309	63	.20	.22	67	246	242
50	26-29	437	136	.31	.27	117	301	320
67	30-33	451	164	.36	.34	152	287	299
80	34-37	341	159	.47	.41	141	182	200
90	38-45	474	254	.54	.53	253	220	221
95	46-49	142	86	.61	.65	93	56	49
99	50-58	118	77	.65	.76	90	41	28
100	59-63	24	17	.71	.85	20	7	4
TOTALS		3108	1030			1033	2078	2075
Chi Square: 36.81 D.F. = 9 Prob (0.0001)								
Model SS : SSTOT = 3948.20 SSR = 3466.72 R^2 = 0.12								
Grouped SS: SSTOT = 3948.20 SSR = 3432.45 R^2 = 0.13								
Difference = 4.27								

Weather Data From Other Sources

We did not evaluate weather data from other sources but offer these insights. As a rule, better models are based on fuel models/indexes that emphasize larger fuel components (ERC, 100-h and 1000-h fuel moisture). Model/indexes emphasizing smaller, more "site-specific" (SC, 1-h and 10-h fuels) always rated lower than their ERC counterparts on fuel models with large fuels. Since 100-h, 1000-h, and ERC are independent of wind, and based on synoptic scale weather and daily boundary conditions, weather information from more synoptic oriented (NWS) stations should compare well on a forest level analysis.

Refining methods of setting manning classes based on an NFDRS index.

Most methods of defining manning classes are based on percentiles of an NFDRS index regardless of associated fire activity. Specifically, most Forest Service units (Helfman and others, AFFIRMS users guide) use values at the 90th and 97th percentile levels to set the very high and extreme class boundaries. The moderate-high class boundary is the one-half the very high value and the low-moderate class boundary is one-half the moderate-high (or a quarter of the very high). Other agencies use the same technique but different percentile levels for setting breakpoints. There is a distinct need for setting manning classes based on "fire business." Our work on this problem was focused at two of our study areas: the Lolo National Forest and the Stanislaus National Forest. Details for the Lolo work are presented here.

We worked with Lolo fire management staff in developing breakpoint values for action plans they were developing. "Fire Day" probability distributions alone are not sufficient for setting breakpoint levels. The analysis file generated during a fire business analysis can be used to produce cumulative distributions of both "all days" and "fire days." Figure 5 illustrates the the cumulative (solid) and probability (dashed) distributions for all days, fire-days, multiple (5+) fire-days, and large (10 acre+) fire-days. (Cumulative distributions of large and multiple fire-days were similar, so only multiple fire days are shown in figure 5.) From our work on choosing the best fuel model/index, we had previously determined ERC (fuel model G), and 1000-h fuel moisture as the best predictors for the Lolo. We limit our discussion here to ERC.

The solid line "All" represents the cumulative distribution of ERC at Lolo for all days of weather, irrespective of fire occurrence. This is the information managers currently use to set levels. The "F-day" cumulative distribution is for days that fires occurred. The shift left indicates fires tend to occur on days of higher ERC. The "Mult-F-day" cumulative distribution represents days where five or more fires occurred and is shifted even further left. There is much information to be gleaned from these distributions with regard to setting levels. For example, below an ERC of 20, there were no multiple (or large) fire-days. Above an ERC of 36, the incidence of multiple fire-days increases markedly. The "fire-day" curve shows a flat response until about an ERC of 26. The probability of large fire-days is small--2 percent overall, but does increase to 15 percent at the maximum observed ERC. The curves also illustrate multiple fire days are twice as likely as a large fire days above ERC values of about 40. Fire-day shows a strong relationship to ERC as the probabilty increases from near zero at minimum values to almost 90 percent at maximum values.

Figure 6 illustrates the relative frequency of all days, fire-days, large fire-days, and multiple fire-days in each of the five manning classes suggested for Lolo using the 90/97th percentile breakpoints. (Class breakpoints are shown in the upper left.) Climatologically, seventy percent of the fire season (05/01-10/31) has a high manning class--and by definition 10 percent comprise very high or extreme. This suggests a constant high state of readiness and a rather significant increase in activity in the transition from moderate to high.

We looked at figure 5 and noticed a couple of things. First, action picked at an ERC of 26, so we called that value low. We also wanted 10 percent of the days in the extreme catagory, so we chose 45 for the lower limit of the extreme class. We then picked 36 as the upper limit of the high class because of the increase in fire-days and multiple fire-days at that level. Figure 7 illustrates the same values as figure 6 using the second set of class criteria.

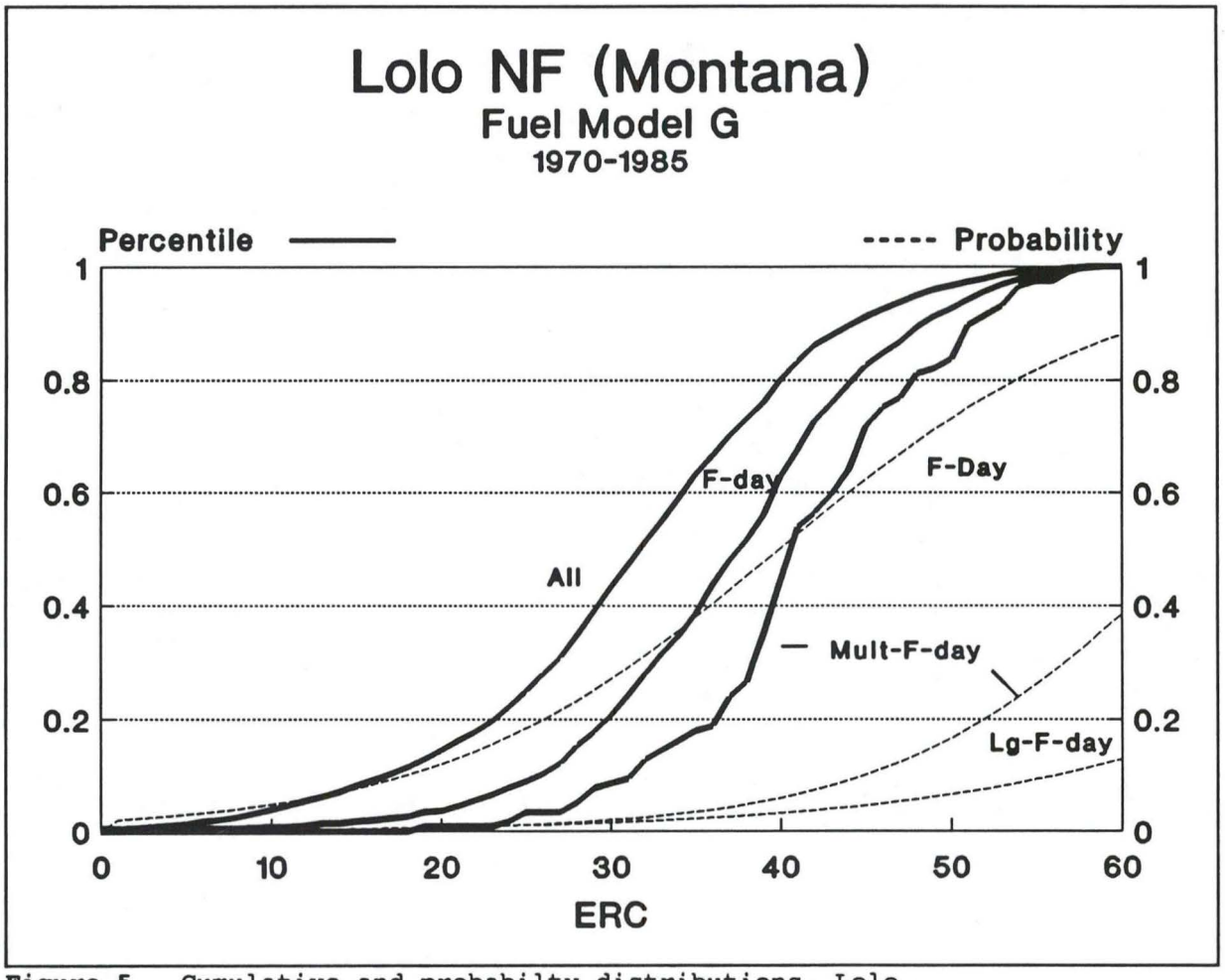


Figure 5. Cumulative and probabilty distributions, Lolo.

Figure 6 illustrates the relative frequency of all days, fire-days, large fire-days, and multiple fire-days in each of the five manning classes suggested for Lolo using the 90/97th percentile breakpoints. (Class breakpoints are shown in the upper left.) Climatologically, seventy percent of the fire season (05/01-10/31) has a high manning class--and by definition 10 percent comprise very high or extreme. This suggests a constant high state of readiness and a rather significant increase in activity in the transition from moderate to high.

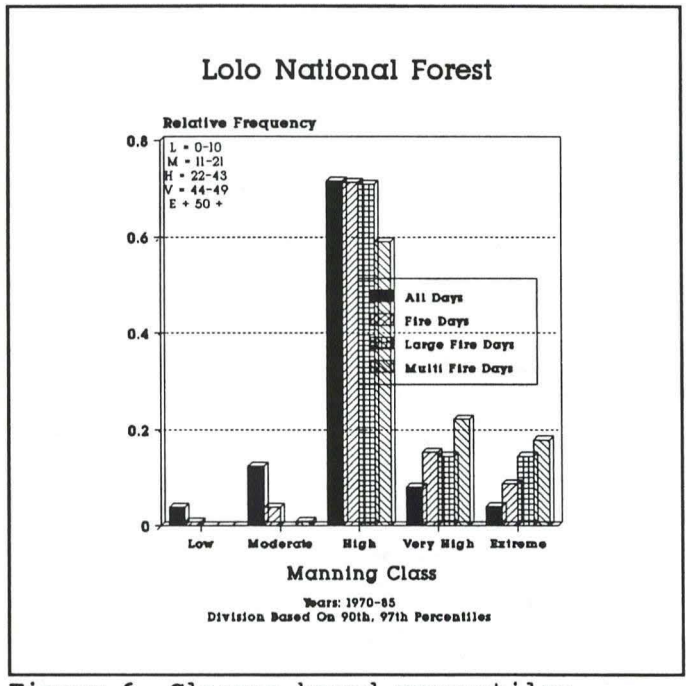


Figure 6. Classes based percentiles

We looked at figure 5 and noticed a couple of things. First, action picked at an ERC of 26, so we called that value low. We also wanted 10 percent of the days in the extreme catagory, so we chose 45 for the lower limit of the extreme class. We then picked 36 as the upper limit of the high class because of the increase in fire-days and multiple fire-days at that level. Figure 7 illustrates the same values as figure 6 using the second set of class criteria. A much larger percentage of the fire-days, large, and multiple fire-days in the very high and extreme catagories. Another pleasing feature of the figure 7 classes is in the transition from high to very high. Although there are nearly the same percentage of days (solid block), the percentage of multiple fire-days almost trebles. A similar relationship is seen in the transition from very high to extreme and the ratio of all days to fire-days, multiple fire-days, and large fire-days. This ratio is the reverse of that noted in the low and moderate classes.

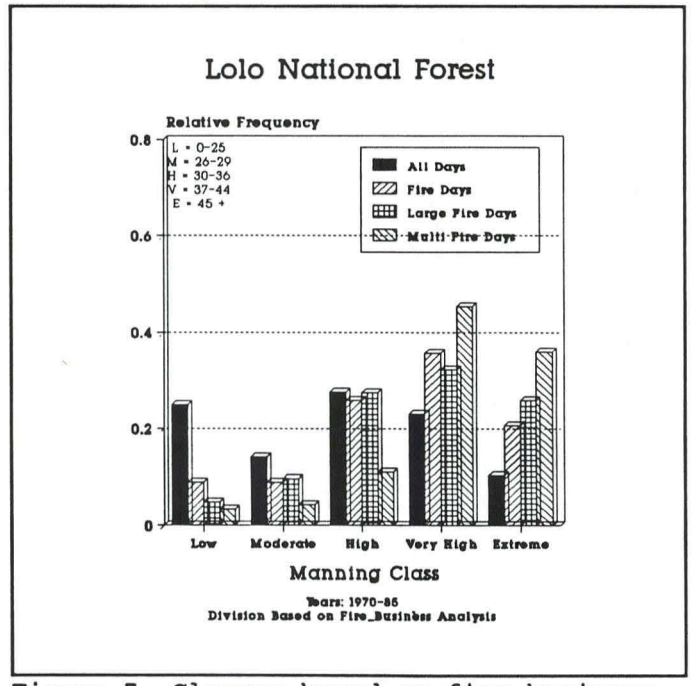


Figure 7. Classes based on fire business

Using figure 7 as a first cut, used our interactive graphics to change boundaries and graph both the manning class relative frequencies and fire-day probabilities in each manning class. After much interaction with the Lolo staff (specifically a request to have overlapping boundaries) we came up with some final recommendations which the Lolo Forest has incorporated into their new fire management action plan. These final levels, along with associated fire-day probabilities are presented and table 13.

Table 13. Final Recommanded Classes for the Lolo Forest Action Plan

Manning Class	ERC Range (Model G)	P(Fire Day)	P(Large Fire Day)	P(Multiple Fire Day)	Percent of Days
Low	0-20	0 to .15	< .01	< .01	15
Moderate	18-30	.16 to .30	< .02	< .02	33
High	28-40	.24 to .55	< .03	< .05	45
Very High	38-45	.45 to .65	< .04	< .09	18
Extreme	46+	> .65	< .10	< .21	9

Stanislaus National Forest - Summary

On the Stanislaus, we used the Mt. Elizabeth (1972-88) data set to assist Gary Biehls in his work to development an All Risk Management plan on the Stanislaus. We worked up five indexes (IC, SC, ERC, BI, and FLI) for six fuel models (B, C, D, G, K, T) and determined that ERC (G) and BI (B) were the best indexes. We presented the results of the BI (B) work at the NARTC training sessions and sent Gary the ERC (G) analysis. He integrated the ERC work with his Forest's NFMAS analysis. Of interest is that both methods indicated similar critical values of ERC and BI. These values have been used in the All Risk Management Analysis to establish Forest activity restrictions.

Interactive Graphics and NARTC Training

Graphics

We downloaded analysis (ANAL) files from the Data General to a PC to facilitate the Graphics after the Data General's CEO PRESENT package proved unsatisfactory for our interactive graphics. The files were manipluated with a database program and passed into the LOTUS spreadsheet program. The spreadsheet contains all the frequency distribution information (all days, fire-days, large-fire days, mulitple fire-days) from the ANAL file for a specific index, plus the fire-day probabilities based on the logistic model for the index. The spreadsheet contains a query area that allows you to set the intervals of a manning class. The query then builds a table similar to table 13. It also generates two bar charts. The first is like figure 6 or 7--relative frequency of fire-days by manning class. The second displays the probabilities of fire-days, large-fire-days, and multiple fire-days for each manning class. The project documentation file contains the database and spreadsheet files for these graphic presentations.

NARTC Training

As we developed our methods and products, we were asked to present them at the 1989 NFDRS course at the National Advance Resource Technology Center in Marana, Arizona. The goals of the course were:

- To create a cadre of regional NFDRS specialist who can assist local operators of NFDRS in both system operations, and trouble shooting/problem solving.

- To prepare managers to property use NFDRS products in developing fire management decision aids.

The two weeks couse has different objectives each week. The first week contains application objectives and is designed for both managers and operators:

- Review NFDRS Design.
- Demonstrate processes required to manage NFDRS.
- Relate NFDRS output to fire business.
- Design a decision model for day-to-day operations.

The second week contains operations objectives and is designed for operators:

- Run NFDRS and supporting software programs
- Analyze inputs and outputs, identify errors, and troubleshoot system problems.
- Adapt NFDRS software to agency specific hardware

We prepared separate two hour lectures for each week. The first lecture was prepared and presented by Patricia Andrews and focused on management applications of the techniques. The second by Larry Bradshaw focused on the processes involved for doing the analysis. both lectures were very well received. The outlines for each lecture, the class comments, and the handouts are contained in appendix B. We were asked to repeat the lectures in 1990 and did so, after integrating the two lectures into a single two-hour lecture for presentation in the first week of the 1990 course to both managers and operators. The outline for the 1990 lecture is also contained in appendix B.

Region 1 Map Polygons

The USDA Forest Service, Northern Region (R1) has adapted the methods and techniques described by Burgan and Hartord (1988) to map relative NFDRS index ratings over 11 polygons that comprise the region. They use ERC, BI, and 1000-h fuel moisture in the maps. The polygons are based on fire weather forecast zones and are illustrated in figure 8. Table 5 summarizes the assignment of representative weather stations within the 11 polygons, the fire weather forecast zones, seasonal dates, total days and fire-days. As described in the earlier discussion on station representativeness in polygon 4, each day's weather is the average of the reporting stations in the polygon. The assignments illustrated in table 5 and figure 8 were determined by the Forest Service when they set up the polygons in 1986. There is limited documentation on their methods.

We wanted to perform a fire business on a polygon level and compare the currently used levels for describing manning (or adjective classes) against a fire business analysis. We first had to assign each Forest/District to a polygon. Table 14 shows these assignments on a forest by forest basis. We generated ANALYSIS data files on polygon levels. Logistic models were fitted for fire-day, large fire-days and multiple fire-days using BI, ERC and 1000-h fuel moisture as independent variables. Figures 9 through 14 summarize some of the basic fire occurrence statistics from the FIRE and ANALYSIS files. We used the ANALYSIS file to compute cumulative distributions of the independent variables for all days, fire-days, large fire-days, and multiple fire-days for each polygon. These distributions have been plotted and are contained in appendix C. The figures in appendix C are conceptually the same as the Lolo Forest example shown in figure 5 except the cumulative and probability distributions have been split into two figures. The ninety-nine associated goodness-of-fit summary tables (3 models per index per polygon) are contained in the project documentation folder.

Table 15 tabulates the current index ranges for five adjective classes based on ERC for each polygon. The percentiles levels used to determine the ranges are given given at the top of the table and are from Burgan (personal communication). Table 16 tabulates these index ranges for BI and table 17 for 1000-h fuel moisture. Table 17 summarizes these breakpoints for each polygon/index and adds the probability of a fire-day, large fire-day, and multiple fire-days at each of the adjective classes.

Figure 8. Northern Region NFDR Map Polygons

Table 14. Forest/District Polygon Assignments for Fire Occurrence

Region One Polygon Assignments: Beaverhead NF (02)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Dillon	1	107	7
Wise River	2	107	7
Wisdom	3	107	7
Sheridan	6	107	7
Madison	7	107	7

Region One Polygon Assignments: Bitterroot NF (03)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Stevensville	1	105	3
Darby	2	103/105	3
Sula	3	103	3
West Fork	4	103	3

Region One Polygon Assignments: Idaho Panhandle NF (04)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Wallace	1	101	1
Avery	2	102	2
Fernan	3	101	1
St. Maries	4	102	2
Sandpoint	6	101	1
Bonners Ferry	7	101	1
Priest Lake	8	101	1

Table 14 (cont). Forest/District Polygon Assignments for Fire Occurrence.

Region One Polygon Assignments: Clearwater NF (05)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Pierce	1	102	2
Palouse	2	102	2
North Fork	3	102	2
Lochsa	5	102	2
Powell	6	102	2

Region One Polygon Assignments: Custer NF (08)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Sheyenne	1		11
Beartooth	2	111	11
Sioux	3	116 (ND)	11
Ashland	4	115	11
Grand River	6	116	11
Medora	7	114	11
McKenzie	8	114	11

Region One Polygon Assignments: Deerlodge NF (09)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Deerlodge	1	106	6
Jefferson	2	106/107	6
Phillipsburg	3	106	6
Butte	4	106	6

Table 14 (cont). Forest/District Polygon Assignments for Fire Occurrence.

Region One Polygon Assignments: Flathead NF (10)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Swan Lake	1	104	4
Spotted Bear	4	104	4
Hungry Horse	6	104	4
Glacier View	7	104	4
Tally Lake	8	104	4

Region One Polygon Assignments: Gallatin NF (11)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Big Timber	1	111/110	9
Livingston	2	111/110	9
Gardiner	3	111	9
Bozeman	6	111	9
Hebgen Lake	7	111	9

Region One Polygon Assignments: Helena NF (12)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Townsend	1	106	6
Helena	2	106	6
Lincoln	4	106	6

Table 14 (cont). Forest/District Polygon Assignments for Fire Occurrence.

Region One Polygon Assignments: Kootenai NF (14)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Rexford	1	101	1
Fortine	3	101	1
Three Rivers	4	101	1
Libby	5	101	1
Fisher River	6	101	1
Cabinet	7	101	1

Region One Polygon Assignments: Lewis & Clark NF (15)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Rocky Mountain	1	108	8
Judith	4	110/112	6
Musselshell	6	110/112	6
Kings Hill	7	110	6

Region One Polygon Assignments: Lolo NF (16)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Missoula	3	105	5
Ninemile	4	105	5
Plains/T. Falls	5	104	4
Seeley Lake	6	105	5
Superior	7	104	4

Table 14 (cont). Forest/District Polygon Assignments for Fire Occurrence.

Region One Polygon Assignments: Nez Perce NF (17)			
Ranger District	ADP Code	Fire Weather Forecast Zone	R1 NFDRS Polygon
Salmon River	1	103	3
Clearwater	4	103	3
Red River	5	103	3
Moose Creek	6	103	3
Fenn	7	103	3
Elk City	8	103	3

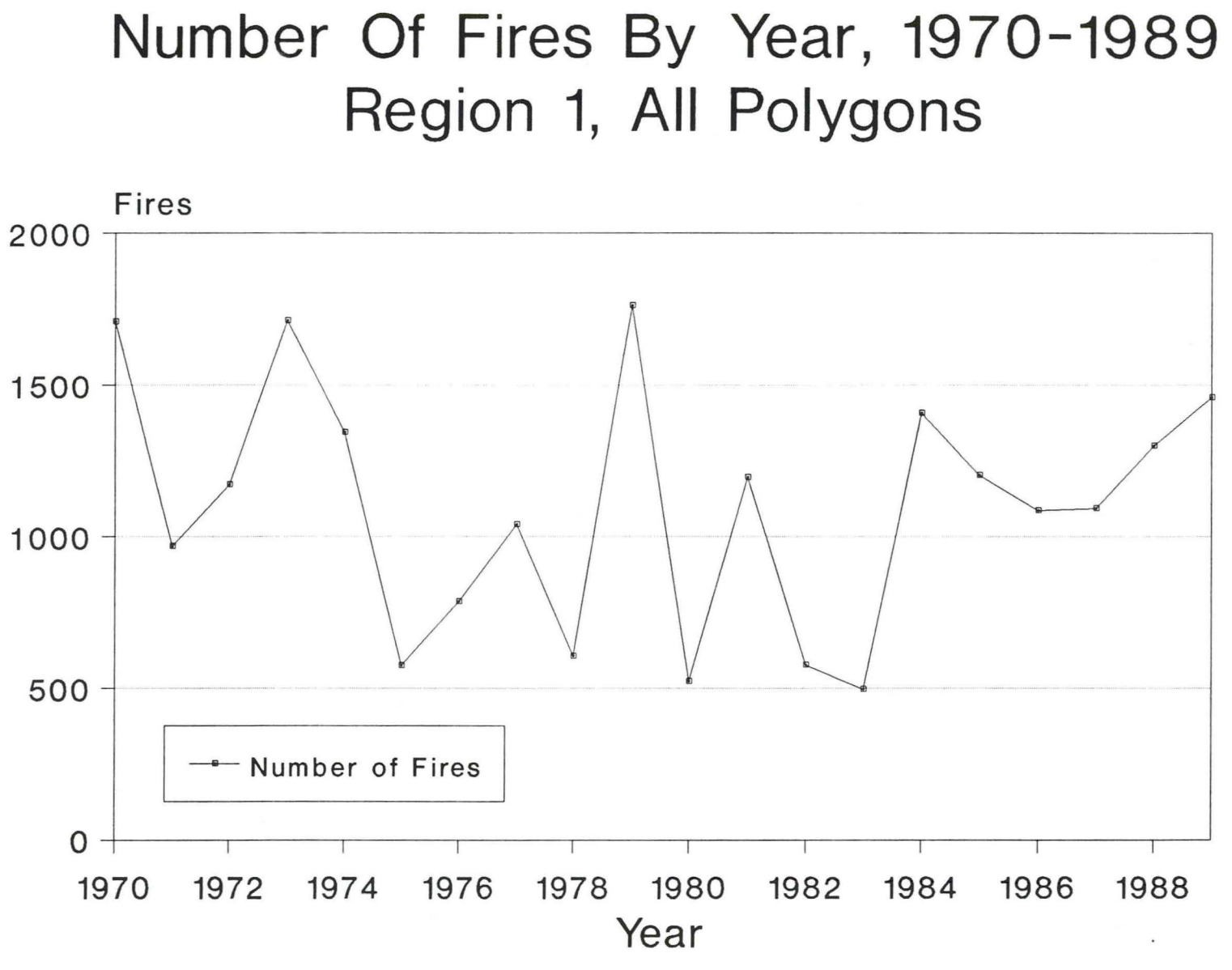


Figure 9. Fires by year, Region 1--All Polygons Combined

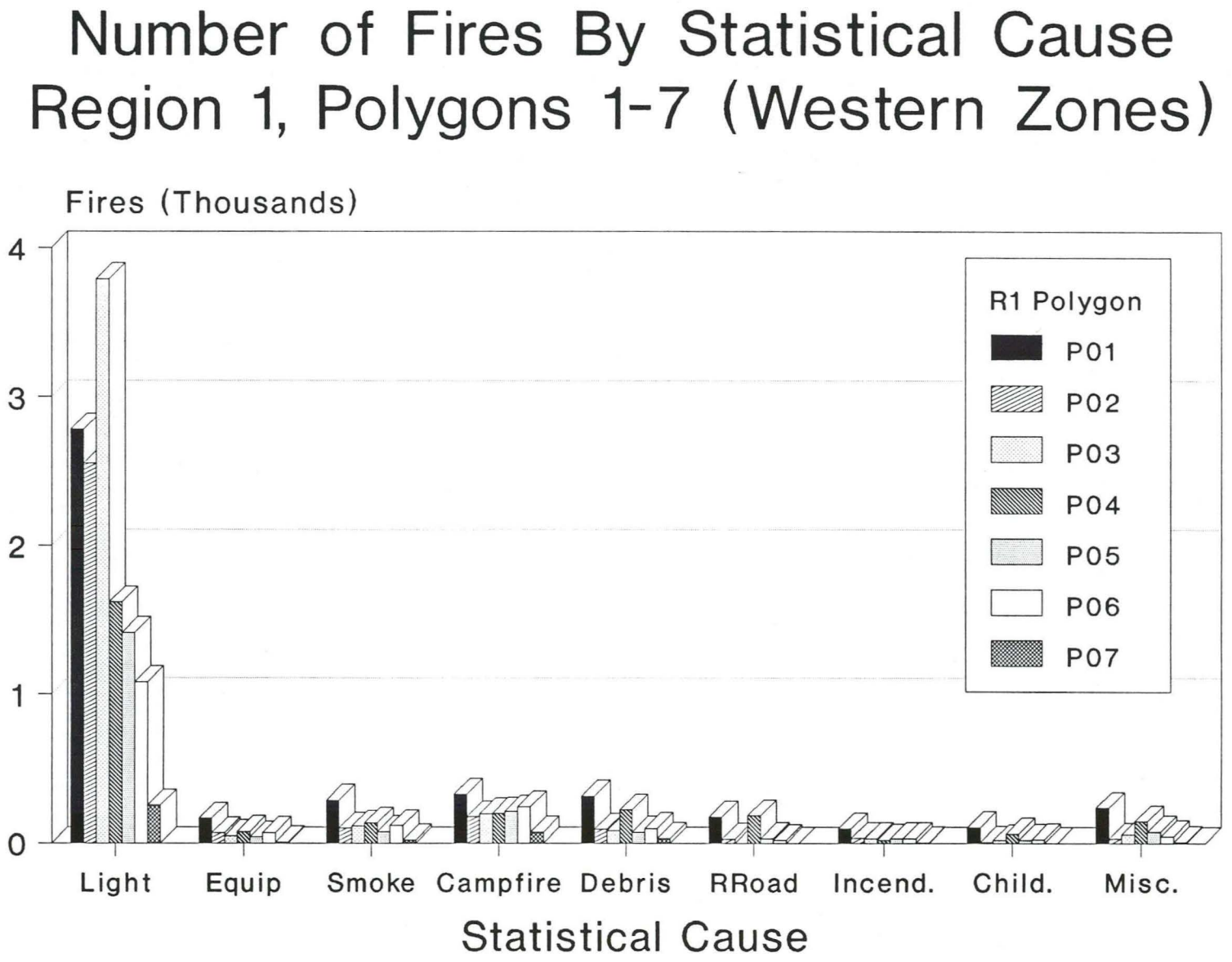


Figure 10. Fires by statistical cause, Western zones

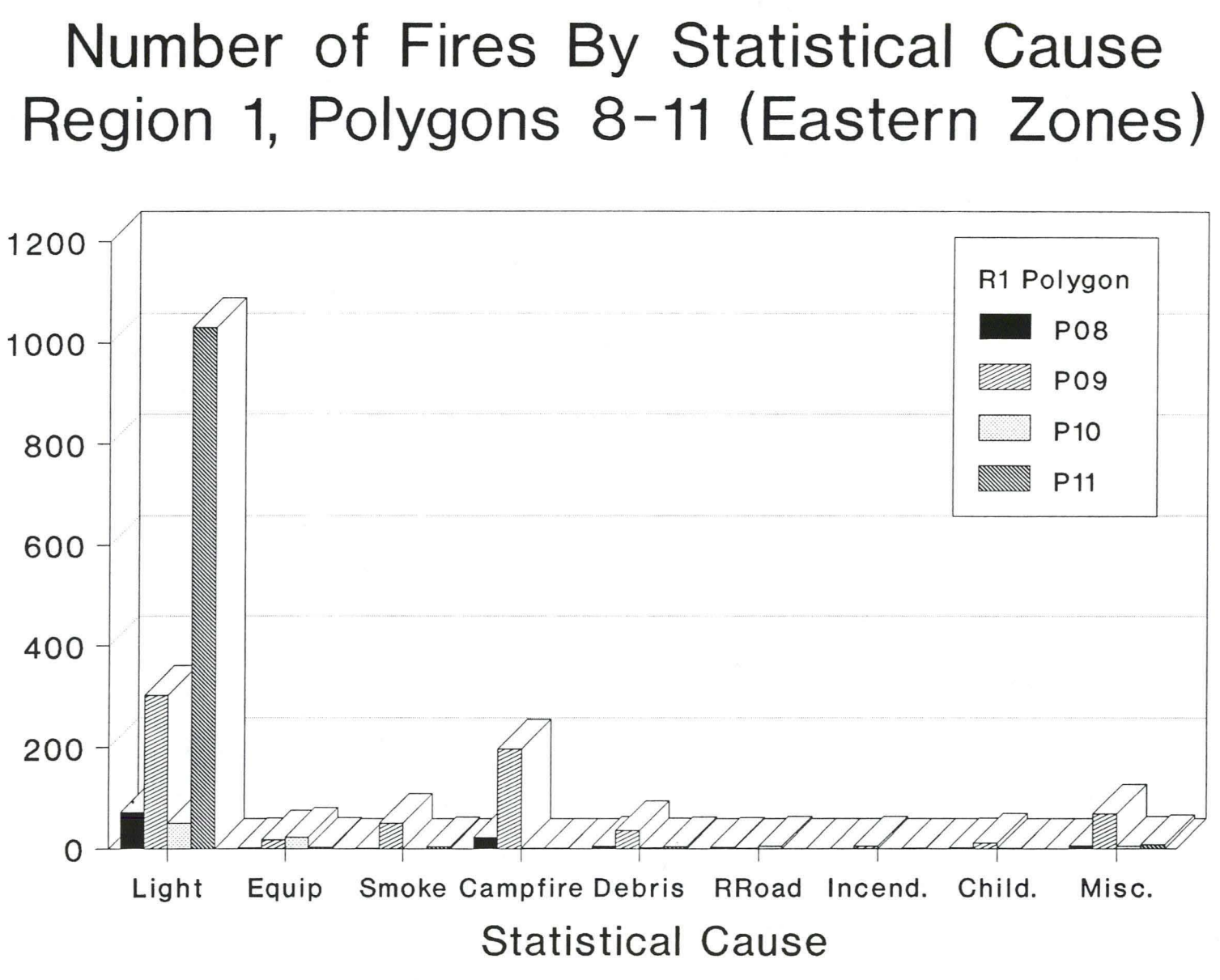


Figure 11. Fires by statistical cause, Eastern zones

Figure 12. Fires by month by polygon.

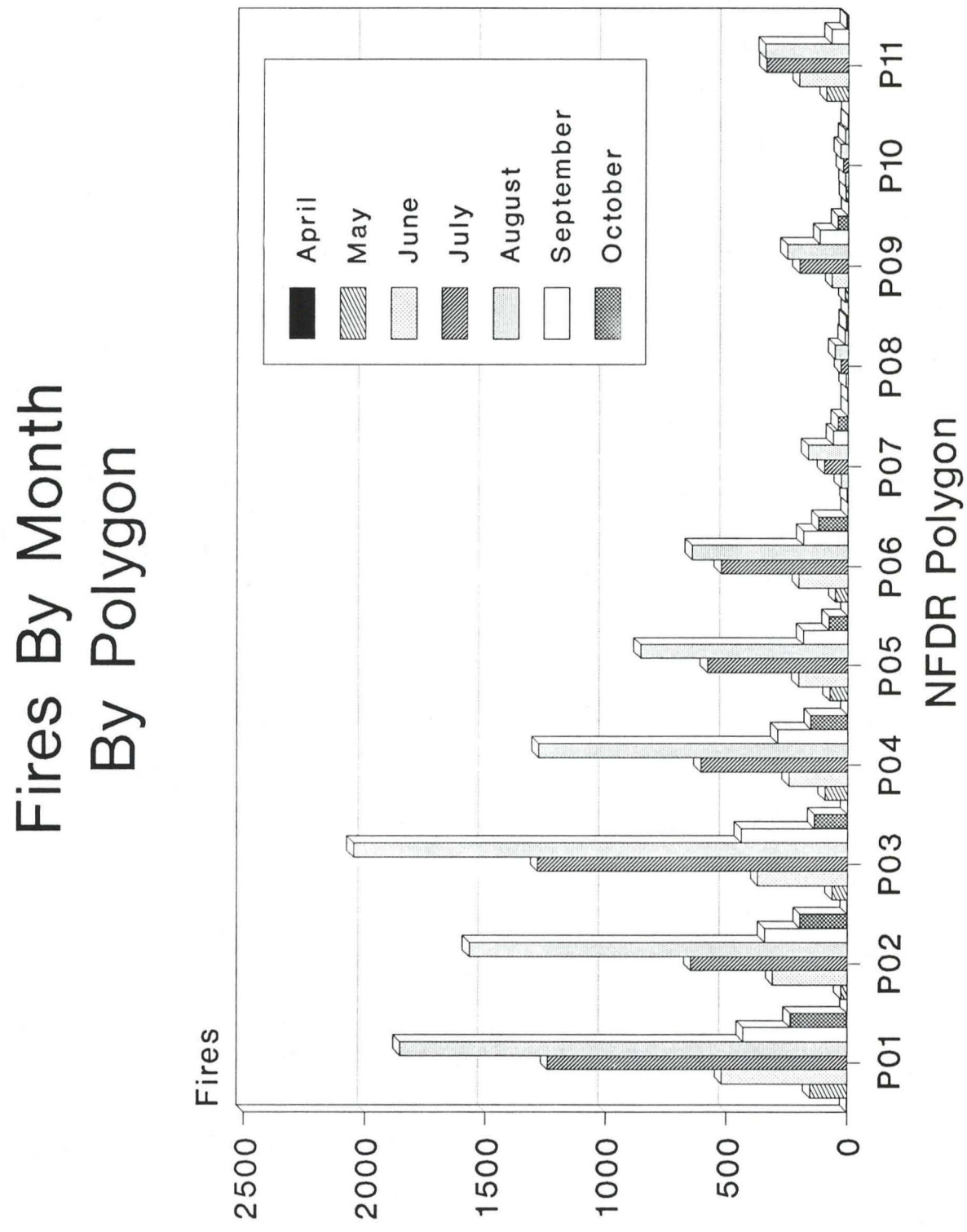
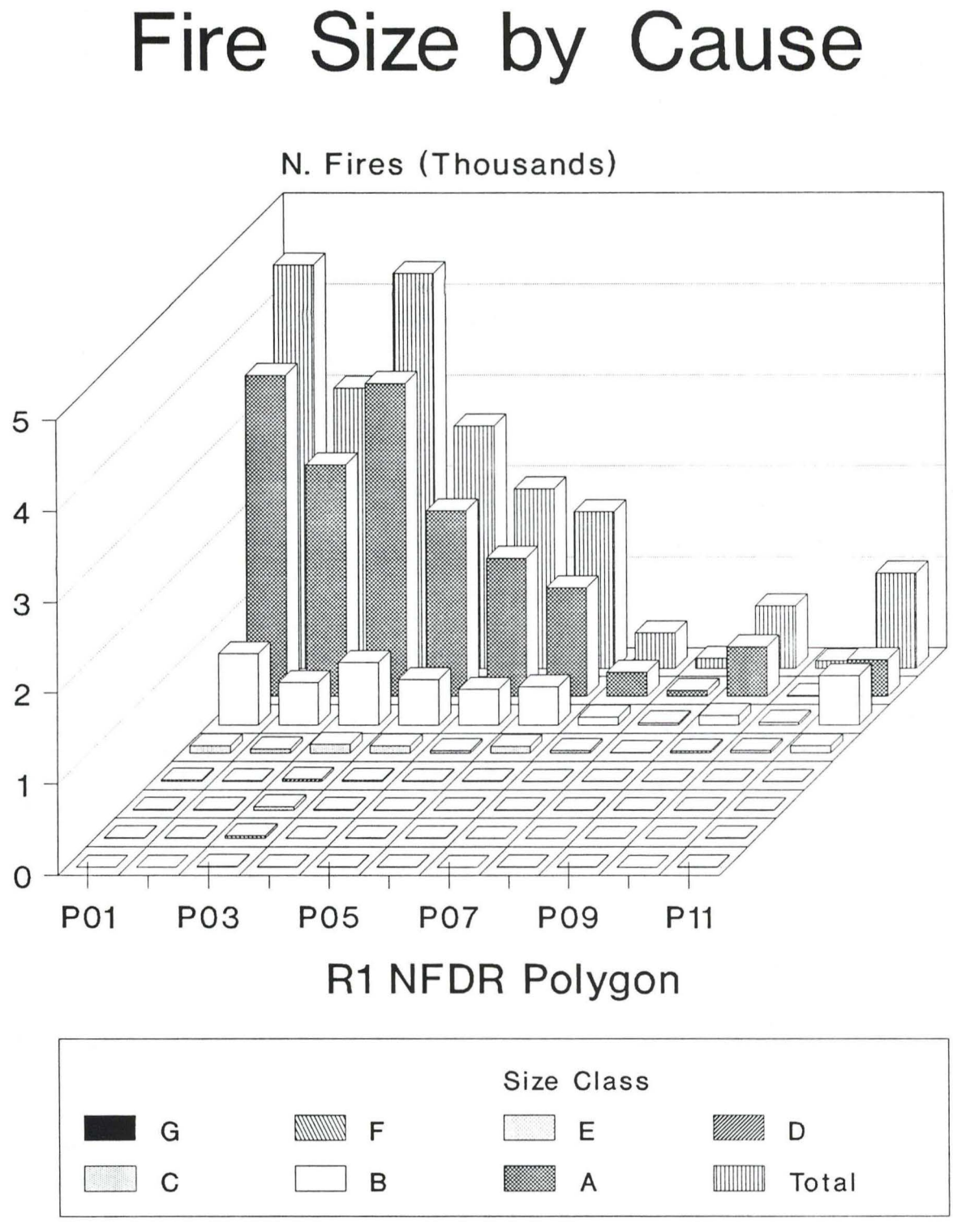


Figure 13. Fire size class by polygon.



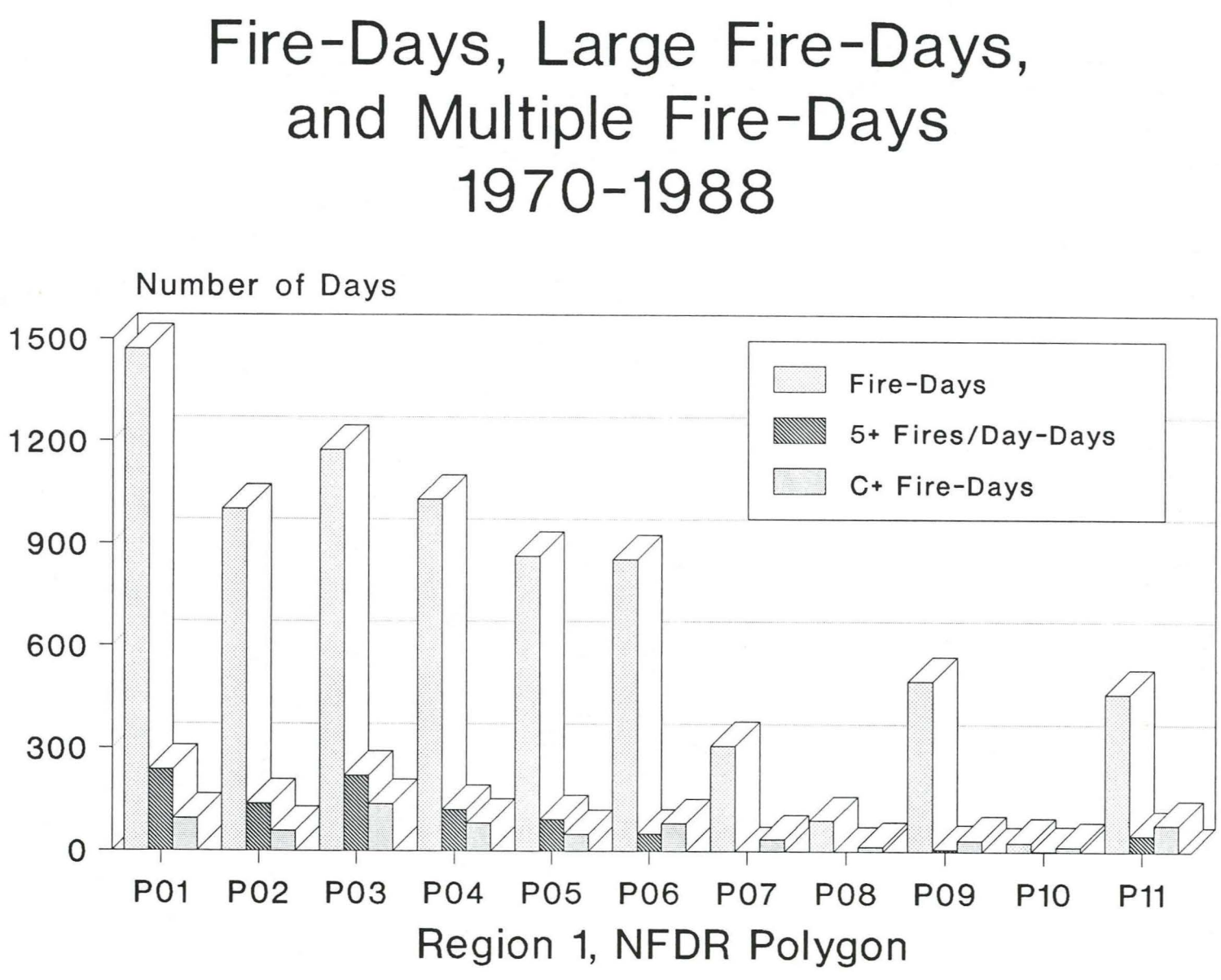


Figure 14. Fire-day frequencies, by polygon.

Table 15. ADJECTIVE CLASS BREAKPOINTS FOR R1 POLYGONS - INDEX IS ERC

Percentile Levels are: Low 0-19; Moderate 20-49; High 50-79; Very High 80-94; Extreme 95+

Polygon/Model	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
P01/G	< 17	18-22	23-27	28-34	35+
P02/G	< 18	18-23	24-29	30-36	37+
P03/G	< 15	15-22	23-29	30-35	36+
P04/G	< 24	24-27	28-31	32-35	36+
P05/G	< 22	22-29	30-33	34-40	41+
P06/G	< 20	21-30	31-37	38-42	43+
P07/G	< 24	24-30	31-35	36-39	40+
P08/G	< 19	19-21	22-24	25-27	28+
P09/G	< 16	16-27	28-36	37-40	41+
P10/C	< 5	5-6	6-7	8-10	11+
P11/C	< 6	6-7	8-9	9-12	12+

Table 16. ADJECTIVE CLASS BREAKPOINTS FOR R1 POLYGONS - INDEX IS BI

Percentile Levels are: Low 0-44; Moderate 45-66; High 67-89; Very High 90-96; Extreme 97+

Polygon/Model	LOW	MODERATE	HIGH	VERY HIGH	EXTREME
P01/G	< 26	26-31	32-39	40-46	47+
P02/G	< 28	28-34	34-44	45-54	55+
P03/G	< 27	27-33	34-43	44-51	52+
P04/G	< 28	28-33	34-42	43-50	51+
P05/G	< 30	30-35	36-43	44-49	50+
P06/G	< 30	30-38	39-53	55-65	66+
P07/G	< 32	32-40	41-54	55-64	65+
P08/G	< 26	26-33	34-45	46-57	58+
P09/G	< 30	30-38	39-51	52-61	62+
P10/C	< 10	10-15	16-25	26-34	35+
P11/C	< 12	12-18	19-29	30-39	40+

Table 17. ADJECTIVE CLASS BREAKPOINTS FOR R1 POLYGONS - INDEX IS 1000 HR FM					
Polygon	LOW	MODERATE	HIGH	VERY HIGH	
P01-P11	20 +	15-20	10-15	0-10	

Table 18. R1 Polygon Class Breakpoint Summary and Fire-Day Probability Values for Five Manning Classes and Three NFDRS Indexes

		CLASS BREAKPOINTS					FIRE DAYS					LARGE FIRE DAY					MULTIPLE FIRE DAYS				
		L	M	H	VH	EX	L	M	H	VH	EX	L	M	H	VH	EX	L	M	H	VH	EX
P01	BI	25	31	39	46	60	.38	0.52	0.7	0.82	0.95	0.01	0.02	0.05	0.1	0.31	0.04	0.07	0.13	0.22	0.49
	ERC	16	22	27	34	45	0.19	0.33	0.48	0.68	0.89	0.01	0.01	0.02	0.04	0.13	0.01	0.03	0.05	0.11	0.31
	FM1000	20	15	10	8	5	0.3	0.76	0.96	0.98	0.99	0.01	0.07	0.34	0.53	0.79	0.02	0.18	0.71	0.87	0.96
P02	BI	27	34	44	54	60	0.28	0.36	0.5	0.65	0.72	0.01	0.02	0.03	0.06	0.09	0.03	0.05	0.07	0.12	0.15
	ERC	17	23	29	36	45	0.18	0.26	0.37	0.51	0.68	0.01	0.01	0.02	0.03	0.06	0.02	0.03	0.04	0.07	0.13
	FM1000	20	15	10	8	5	0.24	0.57	0.85	0.91	0.96	0.01	0.04	0.19	0.32	0.57	0.02	0.1	0.37	0.54	0.77
P03	BI	26	33	43	51	60	0.28	0.37	0.52	0.63	0.75	0.02	0.03	0.07	0.13	0.24	0.05	0.06	0.1	0.15	0.22
	ERC	14	22	29	35	45	0.15	0.26	0.39	0.51	0.71	0.01	0.02	0.03	0.06	0.15	0.02	0.04	0.06	0.1	0.19
	FM1000	20	15	10	8	5	0.25	0.61	0.88	0.93	0.97	0.01	0.1	0.45	0.65	0.87	0.04	0.21	0.61	0.76	0.9
P04	BI	27	33	42	50	60	0.26	0.34	0.47	0.59	0.72	0.01	0.02	0.04	0.06	0.11	0.02	0.03	0.05	0.08	0.14
	ERC	23	27	31	35	45	0.2	0.26	0.33	0.4	0.6	0.01	0.01	0.02	0.03	0.06	0.01	0.02	0.03	0.04	0.09
	FM1000	20	15	10	8	5	0.21	0.49	0.78	0.86	0.93	0.01	0.04	0.18	0.3	0.52	0.01	0.07	0.32	0.5	0.76
P05	BI	29	35	43	49	60	0.26	0.34	0.46	0.56	0.72	0.01	0.02	0.03	0.05	0.1	0.02	0.03	0.06	0.08	0.16
	ERC	21	29	33	40	45	0.15	0.26	0.33	0.47	0.58	0.00	0.01	0.01	0.03	0.05	0.01	0.02	0.03	0.06	0.09
	FM1000	20	15	10	8	5	0.17	0.48	0.81	0.89	0.95	0.00	0.03	0.31	0.55	0.85	0.01	0.07	0.43	0.67	0.89
P06	BI	29	38	53	65	70	0.23	0.31	0.47	0.61	0.66	0.01	0.02	0.05	0.1	0.13	0.01	0.01	0.03	0.07	0.09
	ERC	19	30	37	42	45	0.12	0.22	0.32	0.41	0.46	0.01	0.01	0.02	0.03	0.04	0.00	0.01	0.01	0.02	0.03
	FM1000	20	15	10	8	5	0.16	0.36	0.63	0.73	0.84	0.01	0.03	0.12	0.2	0.38	0.00	0.02	0.1	0.2	0.43
P07	BI	31	40	54	64	70	0.08	0.11	0.16	0.21	0.25	0.01	0.01	0.02	0.03	0.04	***	***	***	***	***
	ERC	23	30	35	39	45	0.05	0.08	0.11	0.14	0.21	0.00	0.01	0.01	0.02	0.03	***	***	***	***	***
	FM1000	20	15	10	8	5	0.04	0.15	0.45	0.6	0.79	0.00	0.02	0.11	0.21	0.46	***	***	***	***	***
P08	BI	26	33	45	57	65	0.03	0.04	0.06	0.09	0.12	0.00	0.01	0.01	0.02	0.02	***	***	***	***	***
	ERC	18	21	24	27	35	0.02	0.03	0.03	0.04	0.05	0.00	0.00	0.00	0.00	0.01	***	***	***	***	***
	FM1000	20	15	10	8	5	0.03	0.08	0.19	0.27	0.41	0.00	0.01	0.07	0.13	0.3	***	***	***	***	***

		CLASS BREAKPOINTS					FIRE DAYS					LARGE FIRE DAY					MULTIPLE FIRE DAYS				
		L	M	H	VH	EX	L	M	H	VH	EX	L	M	H	VH	EX	L	M	H	VH	EX
P09	BI	29	38	51	61	70	0.12	0.19	0.32	0.45	0.57	0.00	0.01	0.03	0.06	0.1	0.00	0.00	0.00	0.01	0.01
	ERC	15	27	36	40	45	0.06	0.12	0.2	0.24	0.31	0.00	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00
	FM1000	20	15	10	8	5	0.11	0.24	0.46	0.56	0.7	0.01	0.02	0.05	0.07	0.14	0.00	0.00	0.01	0.01	0.02
P10	BI	9	15	25	34	45	0.01	0.01	0.02	0.04	0.07	0.00	0.01	0.01	0.02	0.06	0.00	0.00	0.00	0.00	0.00
	ERC	4	6	7	10	15	0.01	0.01	0.02	0.03	0.06	0.00	0.01	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.00
	FM1000	20	15	10	8	5	0.01	0.01	0.03	0.04	0.05	0.00	0.01	0.02	0.04	0.08	0.00	0.00	0.00	0.01	0.1
P11	BI	11	18	29	39	60	0.15	0.15	0.14	0.14	0.13	0.02	0.02	0.04	0.05	0.1	0.01	0.02	0.02	0.02	0.02
	ERC	5	7	9	12	15	0.14	0.15	0.15	0.16	0.16	0.02	0.02	0.03	0.04	0.05	0.01	0.01	0.02	0.02	0.02
	FM1000	20	15	10	8	5	0.06	0.14	0.3	0.39	0.53	0.00	0.02	0.08	0.13	0.27	0.00	0.01	0.04	0.07	0.14

Minimal Data Requirements

We did not have time to perform a statistical analysis of the minimal data requirements for good fire business analysis. Yet, after working with the many data sets in both this and previous studies we make these observations.

An analysis area should have at least a 10 year climatology of weather and fire occurrence data. Minimum data elements:

Climatic:

10 year climatology
Date/hour of observation,
Observation time temperature and humidity,
Maximum/minimum daily temperatures and humidity, and
24-hour precipitation amount and duration.

Fire Occurrence:

Date of discovery,
Administrative unit of fire (to match with a weather station/polygon, etc.)
Statistical cause, and
Final size class.

Areas with overall fire-day rates of less than 15 percent of total days typically produce poor logistic model of fire-day probability. Analysis areas that generally produced poor logistic models were:

Bude District, Mississippi, and
Region 1 polygons 08, 10, and 11.

Analysis areas with fire-day rates over 25 percent usually produced good to excellent logistic models. Example analysis areas were:

Black Creek, Mississippi
Lolo National Forest, Montana
Stanislaus National Forest, California, and
Region 1 polygons 1-6.

Analysis area with fire-day rates from 15 to 25 percent produced a mixed bag of logistic models. Example areas are:

Custer Forest, Montana
Lolo Forest (Districts), Montana, and
Region 1 polygons 7 and 9.

Recommended System Design

We have worked with many large data sets and evaluated many indexes and logistic models. We have presented our initial methods and preliminary results at two formal NFDRS training sessions. We have also made presentations to Forest Service, Park Service, State, and Bureau of Land Management fire management staff. The interaction of the databases and models to perform these analyses is not simple, yet potential users require a simple way to do it. Otherwise, the methods will never be used--regardless of their value. We have heard that repeatedly in our interactions with fire staff. Some tools developed by this study were adopted as a National System by Aviation and Fire Management, Washington Office. We recently were forwarded this message that came to the Washington Office from a Region 8 user's first experience with FCFAST.

> "Used FCFAST to generate a runstream and had no documentation on the program or training. Worked fantastic. Whoever developed this deserves an award or bonus. Please pass on my heartfelt thanks to the individuals involved in the development of this fantastic tool. Working with Fort Collins should now be a breeze."

Buoyed by our successes in methods, results, and technology transfer, we are prepared to recommend a system design that will allow fire managers to incorporate logistic models into their fire management tasks. It will be a component of the integrated fire behavior/fire danger rating system under development by RWU 4401 but does not require this system to be completed for its development. In fact, since the future fire danger system may use new indexes (such as drought codes), our methods and tools will be used to evaluate their (the indexes) correlation to fire business. Figure 15 describes the general flow of information within the system, which we call FIRES.

FIRES provides the framework to perform the tasks required to access, retrieve, merge, and analyze index and fire files. It will generate and analyze fire-day probability functions, and fire-day cumulative distributions. Finally, it will provide guidance in setting decision points and comparing the "fire business" value of different indexes. The NFDRS-FIRDAT in figure 15 can be any fire danger rating processor--the 1978 NFDRS, 1988 NFDRS, the

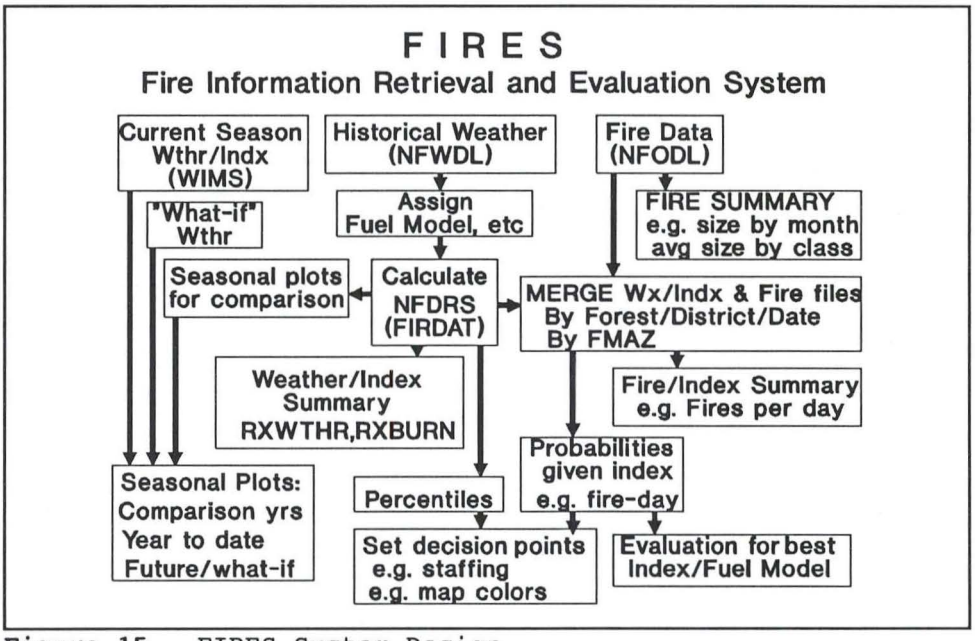

FIRES
Fire Information Retrieval and Evaluation System
Current Season Wthr/Indx (WIMS)
Historical Weather (NFWDL)
Fire Data (NFODL)
"What-if" Wthr
Assign Fuel Model, etc
FIRE SUMMARY e.g. size by month avg size by class
Seasonal plots for comparison
Calculate NFDRS (FIRDAT)
MERGE Wx/Indx & Fire files By Forest/District/Date By FMAZ
Weather/Index Summary RXWTHR,RXBURN
Fire/Index Summary e.g. Fires per day
Probabilities given index e.g. fire-day
Seasonal Plots: Comparison yrs Year to date Future/what-if
Percentiles
Set decision points e.g. staffing e.g. map colors
Evaluation for best Index/Fuel Model

Figure 15. FIRES System Design

next generation NFDRS, or even the Canadian system. In summary, FIRES will provide fire business analysis capabilities, not fire danger rating capabilities.

Some components of FIRES currently exist, or are under development. FCFAST will perform the tasks of extracting historical weather (NFWDL), fire danger rating indexes (FIRDAT), and fire occurrence (NFODL) data. The Weather Information Management System, (WIMS, in development, USDA Forest Service) will provide current season weather and fire danger indexes for past to current comparisons.

Based on our work over the past year, and many interactions with fire managers and potential users, we propose the following features and constraints for FIRES:

Features:

- o Personal Computer based
- o Stand alone system
- o Links to future fire danger rating systems
- o Menu-driven user interface
- o Self-contained database, statistical and graphics functions
- o No special software requirements (e.g. SAS, ATLAS Graphic, LOTUS)
- o Interactive process for setting and displaying manning levels
- o Allow batch processing of statistical functions
- o Semi-automated access to standard Forest Service databases
- o Allow user-defined input data formats for non Forest Service data
- o Compatible with current National Systems (NFWDL, NFODL, NFMAS, WIMS)

Constraints:

- o Personal Computer based
- o Limited number of models/indexes per analysis
- o NFDRS not part of system; index files imported into system

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Appendix A

FCFAST Documentation

Maintenance Manual

Draft Paper Submitted to Fire Managment Notes

Data General User Notes

Personal Computer User Notes

FCFAST

Fort Collins Fire Access Software

Program Technical Documentation and Maintenance Manual

Larry S. Bradshaw

Systems for Environmental Management
Missoula, Montana
December, 1990

Preface

This work was supported in part by funds provided by the U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

Introduction

Fort Collins Fire Access Software (FCFAST) is a utility designed to assist the casual user of the USDA, Fort Collins Computer Center (FCCC) in accessing two databases and one software package often used in fire management planning. It removes the burden of remembering (or learning) FCCC syntax and using a text editor to put values in appropriate columns on ordered records for each application.

The databases FCFAST accesses are:

1. NFWDL - The National Fire Weather Data Library (Furman and Brink, 1975), and

2. NFODL - The National Fire Occurrence Data Library (Yancik and Roussopoulos, 1982).

FCFAST does not perform analysis on datasets from a library-- it extracts, and optionally, downloads them to a remote site where they may be used locally.

The other function of FCFAST is to generate FIREFAMILY (FIRDAT, SEASON, FIRINF) runs at FCCC, and optionally, create 'passing files.' FCFAST will generate either 1978 (Main and others 1982), or 1988 (Main and others, 1990) runs of FIREFAMILY. Like datasets extracted from a library, passing files may be downloaded to a host computer for local use.

Implementation:

There are two versions of FCFAST. One is for use on the Forest Service, Data General Computers. The other is a Personal Computer (PC) version. FCFAST was written using the Forest Service Application Toolkit (FSAT-Screen Utilities Library) to achieve a CEO-like format (menus, data entry screens, and function keys).

The DG version creates runstreams for transmission to FCCC over the DG network via the QFCCC utility. Completed runs are routed to a user specified staff:drawer. The DG version has a fairly complete interface for performing utility operations on runstream and returned print files within FCFAST.

The PC version uses the PC_FSAT (Aviation & Fire Management, Pacific Northwest Research Station, Seattle, Washington) to achieve an interface similar to the DG version. The PC version creates runstreams for transmission to FCCC over a telephone modem. Completed runs are 'captured' on the PC. The PC version requires no specific communication package-- only that the software be able to transmit an ASCII file to a host, and capture screen activity in a PC file.

Language and Source Code

FCFAST is written in FORTRAN 77 and conforms to the ANSI X3.9-1978 standards. There are two versions of the program, one for the Data General line of computers (AOV/VS), and one for the IBM-PC/AT line of computers.

FCFAST For The Data General (DG)

FCFAST on the DG is an Information Systems (IS) program with a CEO interface. It uses the Forest Service Application Toolkit (FSAT) for the user interface.

The source code is contained in five files:

1. FCFAST.F77 : Main routines and menus
2. NFODL.F77 : NFODL specific routines
3. NFWDL.F77 : NFWDL specific routines
4. FIRDAT.F77 : FIRDAT specific routines
5. UTS.F77 : General utility routines

Two common blocks /FC_COMM/ and /FC_COMM_C/ are used throughout FCFAST. They are defined in the include file:

FCFAST.INC

A third common block /STUFF/ is declared in two routines that use it (FIRDAT and CHK_FD1).

Compiling

Use the standard F77 command to compile a source code file(s):

F77 FCFAST NFODL NFWDL FIRDAT UTS

Linking

FCFAST is completely self-contained except for the FSAT (SCR_+) references. Linking requires /tasks=2 switch to enable the FSAT routines.

F77LINK/tasks=2 FCFAST NFODL NFWDL FIRDAT UTS

This assumes that the FSAT library is on the linker searchlist.

Executing

FCFAST uses a CLI macro to start the program with access to CEO functions. The contents of FCFAST.CLI are:

1. write/l=@null enable fsat
2. x fcfast

An alternative CLI macro (FCFAST_DIST.CLI) may be used to ensure the program is not executed from the software drawer:

```
1. [!eq 0,[!size fcfast.pr]]
2.       write/l=@null enable fsat
3.  x fcfast
4. [!else]
5.  write You should not execute FCFAST from the software folder.
6.  write Change to a working drawer and try again...
7. [!end]
```

External Files

Help File

FCFAST uses the direct access help file, FCFAST_HELP as its help file for all modules. FCFAST_HELP_FILE is created using the FSAT utility program CREATE.HELP.FILE. The text used in creating FCFAST_HELP_FILE is stored in FCFAST.HELP. FCFAST_HELP is then created by renaming, or copying FCFAST_HELP_FILE. The help file must reside in the software drawer with the program file.

Configuration Files

FCFAST uses user specific configuration files to store information needed to initiate FCCC runs and where to send/put returned FCCC print jobs. It also stores the default printer for print requests from within FCFAST.

The file name is a concatenation of 'FC_FAST.CFG_' and the user id (e.g. FC_FAST.CFG_L.BRADSHAW). If the file does not exist, system defaults are used. Option 1 from the utility module allows you to define the values in the configuration file.

NFWDL Index File

FCFAST gets the correct NFWDL data file name from the NFWDL index file 'FCFAST.NDX' which must reside in the software drawer with the program file. It is unlikely that the contents of FCFAST.NDX will need modifying over the course of the lifetime of FCFAST.

Runstream Files

FCFAST creates runstream files in the working directory. All runstream files have .FCC extensions. The following operations may take place on these files: SEND, EDIT, VIEW, PRINT, DELETE.

FCCC Print Files

Returned FCCC print files are stashed by IS in the staff:drawer specified in the job set-up. The folder is always FCFILES. FCFAST uses configurations file's staff:drawer value to perform an INDEX of these files. The following operations may take place on these files: VIEW, PRINT, CLEAN, DELETE, RENAME.

Data Files

Downloaded data in a FCCC print file may be extracted through the CLEAN option. The new data file is created in the working directory unless a full pathname is given for the filename. If a full pathname is given, the user must have write privileges to the specified folder.

Scratch Files

FCFAST uses scratch files in a couple of routines. They are always deleted after use.

System Programs/CLI Commands Used:

FCFAST uses the CLI subroutine to initiate son processes from within FCFAST. It uses: WHO, HOST, DIR, FILESTATUS, SED, VIEW, DELETE, RENAME, QFCCC, and QPRINT/QUE=arg.

It also uses the F77 call to TIME to get the current year.

Program Limits:

A maximum of 20 weather stations may be accessed on a single run from the NFWDL module.

A maximum of 50 FIRDAT lead cards sequences may be generated from within FIRDAT. (Weather will be loaded for up to 50 stations also.)

Contents of Data General Distribution Dump Files

1. FCFAST.DMP	FCFAST Program Dump File.
a. FCFAST.PR	FCFAST program (executable) file.
b. FCFAST.CLI	FCFAST start-up macro (no folder check).
c. FCFAST_HELP	FSAT Called FCFAST help file.
d. FCFAST.NDX	NFWDL Tape/Station index file.
e. FCFAST_DIST.CLI	FCFAST start-up macro (checks folder)
f. FCFAST_README	Quick user notes.
g. INSTALL_NOTES	Installation notes/instructions.
h. MAKE_DUMP.CLI	Macro to make a program dump file.
i. PROGRAM_NOTES	Complete user notes.
2. FCFAST_SRC.DMP	FCFAST Source Code Dump File.
a. DUMP_SRC.CLI	Macro to create source code dump file
b. FCFAST.F77	FCFAST main modules source code file.
c. FCFAST.HELP	SED generated help file.
b. FCFAST.INC	Include file for compiling.
e. FIRDAT.F77	FIRDAT specific source code file.
f. LINK.CLI	FCFAST F77LINK macro.
g. NFODL.F77	NFODL specific source code file.
h. NFWDL.F77	NFWDL specific source code file.
i. UTS.F77	FCFAST utility source code file.

FCFAST For PC

FCFAST on the PC is compiled using Microsoft FORTRAN, version 5.0. It uses the Forest Service Application Toolkit for PC's (PC_FSAT) for the user interface. The PC version is essentially a different program because of differences (include files, and calling parameters) in the PC and DG versions of FSAT. Also, since there is no automatic queuing of job files in the DG version, the whole job file utility section available in the DG is not in the PC version.

The source code is contained in five files:

1. FCFAST.FOR : Main routines and menus
2. NFODL.FOR : NFODL specific routines
3. NFWDL.FOR : NFWDL specific routines
4. FIRDAT.FOR : FIRDAT specific routines
5. UTS.FOR : General utility routines

Two common blocks /FC_COMM/ and /FC_COMM_C/ are used throughout FCFAST. They are defined in the include file:

FCFAST.INC

A third common block /STUFF/ is declared in two routines that use it (FIRDAT and CHK_FD1).

Compiling
The following syntax is used to compile a source code file(s):

FL /C /4Yd /4Nt /4I2 /Ge /Gt100 fcfast.for

Libraries
The following libraries are required:

1. FCFAST.LIB (FCFAST compile object modules)
2. VIDEO.LIB (PC_FSAT video object modules)
3. TOOLS.LIB (PC_FSAT tools)
4. STRINGS.LIB (PC_FSAT string functions)
5. TIMEUTIL.LIB (PC_FSAT time/utility functions)
6. LLIBFORE.LIB (MS Fortran 5.0 Large Memory, 8087 Emulation Library)

Linking
Version 5.03 of the Microsoft Segmented-Executable LINK program (comes with MS Fortran 5.0) is required. The following link command will successfully link FCFAST:

LINK fcfast+dispmenu+poscf+rstcf,,,fcfast+video+tools+strings+timeutil+ llibfore /NOE /ST:20000 /SE:512

Note: I modified the three modules (dispmenu, poscf, and rstcf) in the VIDEO section of PC_FSAT routines so that all fields would NOT be reverse video on color monitors. Inclusion of these modified object modules is recommended, but not required.

Executing
FCFAST **MUST** be executed from the directory the program is stored in unless the DOS **APPEND** command is used to add the \FCFAST directory to the APPEND search list for the help file (FCFAST.HLP).

External Files

Help File
FCFAST uses the direct access help file, FCFAST.HLP as its help file for all modules. FCFAST.HLP is created using the PC_FSAT utility program CRHELP.EXE. The text used in creating FCFAST.HLP is stored in FC_HELP.TXT. The help file must reside in the directory with the program file.

Configuration Files
FCFAST uses user specific configuration files to store information needed to initiate FCCC runs and where the returned FCCC print jobs will be found.

The file name is 'FC_FAST.CFG' and option 1 from the utility module allows you to define the values in the configuration file.

NFWDL Index File
FCFAST gets the correct NFWDL data file name from the NFWDL index file 'FCFAST.NDX' which must reside in the directory with the program file. It is unlikely that the contents of FCFAST.NDX will need modifying over the course of the lifetime of FCFAST.

Runstream Files
FCFAST creates runstream files in the working directory. All runstream files have .FCC extensions. The PC version does not provide utility operations on runstream files.

FCCC Print Files
FCFAST uses configurations file's directory to perform an INDEX of these files. The PC version only allows the CLEAN utility on returned FCCC print files.

Data Files
Downloaded data in a FCCC print file may be extracted through the CLEAN option. The new data file is created in the working directory unless a full pathname is given for the filename.

Scratch Files
FCFAST uses scratch files in a couple of routines. They are always deleted after use.

System Programs/CLI Commands Used:

FCFAST uses the MS 'SYSTEM' function to initiate son processes from within FCFAST. It uses: DIR.

It also uses the MS FORTRAN call to GETDAT to get the current year.

Program Limits:

A maximum of 10 weather stations may be accessed on a single run from the NFWDL module.

A maximum of 10 FIRDAT lead cards sequences may be generated from within FIRDAT. (Weather will be loaded for up to 10 stations also).

PC Distribution Files

1. FCFASTPC.EXE	FCFAST self-extracting distribution file.
a. FCFAST.EXE	FCFAST program.
b. FCFAST.HLP	FCFAST Help file.
c. NFWDL.NDX	NFWDL station/index file.
d. PC_NOTES	Complete PC user notes.
e. PC_READ.ME	FCFAST- PC version readme file.
2. FCFAST.ZIP	
a. CFC.BAT	Batch file to compile single file.
b. C_ALL.BAT	Batch file to compile all files.
c. LFC.BAT	Batch file to link FCFAST.
d. FCFAST.FOR	FCFAST Main program source code file.
e. FIRDAT.FOR	FIRDAT related source code file.
f. NFODL.FOR	NFDOL related source code file.
g. NFWDL.FOR	NFWDL related source code file.
h. UTS.FOR	FCFAST utility source code file.
i. FCFAST.HLP	FCFAST FSAT called help file.
j. FCFAST.INC	FCFAST include file.
k. FCFAST.LIB	FCFAST object module library file.
l. DISPMENU.OBJ	Altered FSAT DISPMENU.FOR object file.
m. POSCF.OBJ	Altered FSAT POSCF.FOR object file.
n. RSTCF.OBJ	Altered FSAT RSTCF.FOR object file.
o. FC_HELP.TXT	FCFAST help file text source file.

FC_FAST.F77	NFODL.F77	NFWDL.F77	FIRDAT.F77	UTS.F77	UTS.F77 (cont)
FCFAST	NFODL	NFWDL	FIRDAT	ANY2CLEAN	NEXT_UNIT
FC_INIT	DECODE	MAKE_NFWDL	LEAD1	ANY2SEND*	QUE*
FC_FAST_MAIN	MAKE_NFODL	NFWDL_DEFAULTS	LEAD2	APPENDC	QUE_INDEX*
FIRDAT_MENU	CHK_FO1	CHK_FW1	LEAD3	BAD	SCAN
NFWDL_MENU		NFWDL_LIST	LEAD4	CHK_CLN*	SCRAM
NFODL_MENU		NFWDL_INV	DUMP	CHK_PATH	SET_CLEAN
UTIL_MENU		MAKE_NFWDL_INV	RJ	CHK_QUE*	SET_JOB
SCRUSERCHECK		CHK_FWI	POINT	CLEAN	SET_QUE*
SCRUSERINDEX			MAKE_FIRDAT	CLEAN_INDEX	SIGNON
			SORT_LEAD	CLI*	SRTSTN
			FIRDAT_DEF	CTOI	YES
			CHK_FD1	DEFAULTS	
			CHK_FD2	ERROR*	
			CHK_FD3	GETDAT2	
			CHK_FD4	GET_DIR*	
			CHK_MOD	GET_HOST*	
			CHK_SLOPE	GET_WHO*	
			CHK_CLIM	IEOS	
			CHK_HERB	INT2CHAR	
			CHK_SHRUB	ISNUM	

FSAT SYSTEM MODULES USED

SCR_CLEAR_SCREEN
SCR_DATA_ENTRY
SCR_DISPLAY_MENU
SCR_DISPLAY_MESSAGE
SCR_DISPLAY_WARNING
SCR__W

Note: SCR__W is an undocumented routine in the FSAT library that allows you to temporarily release the screen from FSAT screen control.

1. To clear screen and allow standard fortran i/o:
   Call scr__w(1,2," ",0,"STDCON,ERASE,FORCE")

2. To reinitalize screen for FSAT use:
   Call scr__w(1,2," ",0,"REINIT')

* Module NOT in PC version of FCFAST

COMMON BLOCK Variable Definitions

```
C...
C... File FCFAST.INC
C... Commons for FCFAST, block /FC_COMM/
C...
      integer MXFD
C-PC      PARAMETER (MXFD=10)
      PARAMETER (MXFD=50)
C...
C...  first_lead?(MXFD) :  .T. signifies first time for lead card n and
c...                       defaults are loaded from memory defaults.  .F.
c...                       signifies edit current values and defaults are
c...                       loaded from firdat_set(n)
c...  first_nfwdl          : same concept as first_lead
c...  first_nfodl          : same concept as first_lead
c...  n_3(MXFD)            : counts number of lead card 3's for station n
c...  n_4(MXFD)            : counts number of lead card 4's for station n
c...  off_3(MXFD)          : when n_3(n) > 3, off_3(n) is set to .T.
c...  off_4(MXFD)          : when n_4(n_ > 3, off_4(n) is set to .T.
c...  queue                          : .T. queue job now, else make file, don't queue
c...
      Logical first_lead1(MXFD),first_lead2(MXFD),first_lead3(MXFD),
     + first_lead4(MXFD),off_3(MXFD),off_4(MXFD),first_nfwdl,first_nfodl,
     + queue
      Integer n_3(MXFD), n_4(MXFD)

      Common /FC_COMM/ first_lead1,first_lead2,first_lead3,
     +  first_lead4,off_3, off_4, first_nfwdl,first_nfodl,queue,
     +  n_3,n_4

C...
C... File FCFAST.INC
C... Commons for FCFAST, block /FC_COMM_C/
C...
c... CX,QX,MM,EX,NX,OK,PS,NS : return codes (defined in FC_FAST_MAIN)
c... stat_name     : affirms station name
c... firdat_set(MXFD):  holding string for FIRDAT info for stations
c... pass_there    :  'Y' passing file exists, else 'N'
c... make_pass     :  'Y' make passing file, else 'N'
c... save_pass     :  'Y' save passing file, else 'N'
c... down_pass     :  'Y' download passing file, else 'N'
c... pass_qual     :  passing file qualifier
c... pass_file     :  passing file name
c... pass_date     :  date to save passing file until (character)
c... pass_desc     :  passing file description
c... fccc_file     :  final fccc_file name (qualifier*filename.)
c... cfg_file      :  configuration file
c... qfile         :  name of job file to create/queue on host
c... qtime         :  time to send job to FCCC
c... printer       :  print device to queue print jobs to
```

```
c...
      Character*15 CX,QX,MM,EX,NX,OK,PS,NS
      Character stat_name*20
      Character*512 firdat_set
      character*1 pass_there,make_pass,save_pass,down_pass
      character pass_qual*12,pass_file*12,pass_date*6,pass_desc*50
      character fccc_file*25,cfg_file*32
      character qfile*20,qtime*10,printer*15

      Common /FC_COMM_C/ CX,QX,MM,EX,NX,OK,PS,NS, stat_name,
     +  firdat_set(MXFD), pass_there,make_pass,save_pass,down_pass,
     +  pass_qual,pass_file,pass_date,pass_desc,qfile,qtime,cfg_file,
     +  printer
c...

C...
C... Commons for FCFAST, block /STUFF/
C...
c... Used in FIRDAT and CHK_FD1 to control whether to skip passing file
c... section of the input screen.  Passing file stuff is only shown on
c... the first station in a sequence.
c...
c... skip          : .t. if first station (station_seq = 1), else .f.
      Logical skip
      Common /STUFF/ skip
c...
c...
```

Module Documentation

The following pages briefly describe the function of all program units in FCFAST.

Described are:

Module Name and Type (PROG, SUBR, FUNC),
Source File containing module,
Module Function,
Referencing Routine(s)
Description of argruments (if any),
Include Files in routine,
Common Blocks Present,
Subroutines referenced,
Functions referenced,
Files used, and
Presence of 'STOP' or 'PAUSE' statements

```
*******************************************************************************
MODULE  : PROG FCFAST                       SOURCE FILE: FC_FAST.F77
FUNCTION:  MAIN PROGRAM MODULE.  INITIALIZES SCREEN AND CALL MAIN MENU
*******************************************************************************
    SUBROUTINES REFERENCED:
      FC_INIT              FC_FAST_MAIN          SCR_CLEAR_SCREEN
      SCR_TERM EXIT

   'STOP' STATEMENT IS PRESENT


*******************************************************************************
MODULE  : SUBR FC_INIT                      SOURCE FILE: FC_FAST.F77
FUNCTION:  INITIALIZES SCREEN FOR I/O.  RETURNS .TRUE. IF DONE OK...
*******************************************************************************
    REFERENCING ROUTINES:  FCFAST

    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE LOG S)
    SUBROUTINES REFERENCED:
      SCR_INIT


*******************************************************************************
MODULE  : SUBR FC_FAST_MAIN                 SOURCE FILE: FC_FAST.F77
FUNCTION:  DISPLAY MAIN MENU AND PROCESS OPTIONS
*******************************************************************************
    REFERENCING ROUTINES:
      FCFAST
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    INCLUDE FILES USED:
      SCR_DISPLAY_MENU.F77.IN       SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      SCR_DISPLAY_MENU      SCRAM                 FIRDAT_MENU
      NFWDL_MENU            NFODL_MENU            UTIL_MENU
    FUNCTIONS REFERENCED:
      GET_WHO
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE) - Configuration File
```

```
*****************************************************************************
MODULE : SUBR FIRDAT_MENU                SOURCE FILE: FC_FAST.F77
FUNCTION: SOLICITS AND PROCESSES FIRDAT OPTIONS
*****************************************************************************
    REFERENCING ROUTINES:
      FC_FAST_MAIN
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    INCLUDE FILES USED:
      SCR_DISPLAY_MENU.F77.IN      SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      SCR_CLEAR_SCREEN     SCR_DISPLAY_MENU      SCRAM
      FIRDAT               SET_QUE               SET_CLEAN


*****************************************************************************
MODULE : SUBR NFWDL_MENU                 SOURCE FILE: FC_FAST.F77
FUNCTION: SOLICITS AND PROCESS NFWDL OPTIONS
*****************************************************************************
    REFERENCING ROUTINES:
      FC_FAST_MAIN
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    INCLUDE FILES USED:
      SCR_DISPLAY_MENU.F77.IN      SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      SCR_CLEAR_SCREEN     SCR_DISPLAY_MENU      SCRAM
      NFWDL                NFWDL_LIST            NFWDL_INV
      SET_QUE              SET_CLEAN


*****************************************************************************
MODULE : SUBR NFODL_MENU                 SOURCE FILE: FC_FAST.F77
FUNCTION: SOLICITS AND PROCESSES NFODL OPTIONS
*****************************************************************************
    REFERENCING ROUTINES:
      FC_FAST_MAIN
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    INCLUDE FILES USED:
      SCR_DISPLAY_MENU.F77.IN      SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      SCR_CLEAR_SCREEN     SCR_DISPLAY_MENU      SCRAM
      NFODL                SET_QUE               SET_CLEAN
```

```
*******************************************************************************
MODULE : SUBR UTIL_MENU                    SOURCE FILE: FC_FAST.F77
FUNCTION: SOLICITS AND PROCESSES UTILITY OPTIONS
*******************************************************************************
   REFERENCING ROUTINES:
     FC_FAST_MAIN
   INCLUDE FILES USED:
     SCR_DISPLAY_MENU.F77.IN      SCR_OFFSETS.F77.IN     FC_FAST.INC
   COMMON BLOCKS PRESENT:
     FC_COMM              FC_COMM_C
   SUBROUTINES REFERENCED:
     DEFAULTS             SET_QUE


*******************************************************************************
MODULE : SUBR SCRUSERCHECK                 SOURCE FILE: FC_FAST.F77
FUNCTION: CALL CORRECT SCREEN CHECKING ROUTINE BASED ON SCREEN NUMBER
*******************************************************************************
   REFERENCING ROUTINES:
        FSAT SYSTEM
   PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 AR)
   INCLUDE FILES USED:
     SCR_SUBROUTINE.F77.IN
   SUBROUTINES REFERENCED:
     CHK_FW1              CHK_FWI              CHK_FD1
     CHK_FD2              CHK_FD3              CHK_FD4
     CHK_FO1              CHK_QUE              CHK_CLN
     CHK_PATH


*******************************************************************************
MODULE : SUBR SCRUSERINDEX                 SOURCE FILE: FC_FAST.F77
FUNCTION: CALLS CORRECT INDEX ROUTINE BASED ON SCREEN NUMBER
*******************************************************************************
   REFERENCING ROUTINES:
     FSAT SYSTEM
   PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 AR)
   INCLUDE FILES USED:
     SCR_SUBROUTINE.F77.IN
   SUBROUTINES REFERENCED:
     CLEAN_INDEX          QUE_INDEX
```

```
*****************************************************************************
MODULE : SUBR NFODL                    SOURCE FILE: NFODL.F77
FUNCTION: GETS NFODL DATA FETCH OPTIONS
*****************************************************************************
   REFERENCING ROUTINES:
     NFODL_MENU
   INCLUDE FILES USED:
     SCR_DATA_ENTRY.F77.IN  SCR_OFFSETS.F77.IN    FC_FAST.INC
   SUBROUTINES REFERENCED:
     SCR_CLEAR_SCREEN     SCR_DATA_ENTRY       MAKE_NFODL
     DECODE               QUE                  SCRAM
   FUNCTIONS REFERENCED:
     INT2CHAR


*****************************************************************************
MODULE : SUBR DECODE                   SOURCE FILE: NFODL.F77
FUNCTION: DECODES A LIST OF FOREST/DISTRICT SPECS INTO GROUPS
*****************************************************************************
   REFERENCING ROUTINES:
     MAKE_NFODL
   PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 AR ARRAY INT S,
     VARIABLE INT SR, VARIABLE LOG S)
   SUBROUTINES REFERENCED:
     ERROR
   FUNCTIONS REFERENCED:
     IEOS                 INDEX


*****************************************************************************
MODULE : SUBR MAKE_NFODL               SOURCE FILE: NFODL.F77
FUNCTION: GENERATES THE NFODL FCCC JCL IMAGE
*****************************************************************************
   REFERENCING ROUTINES:
     NFODL
   PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 AR, VARIABLE LOG SR,
     VARIABLE LOG R, VARIABLE INT R, ARRAY INT R, VARIABLE LOG R)
   SUBROUTINES REFERENCED:
     DECODE               SIGNON
   FUNCTIONS REFERENCED:
     IEOS                 CTOI                 INDEX
   FILES USED:
     UNIT=(L)LU9(OPEN,READ,WRITE,REWND,CLOSE) - Scratch file, holds NFODL
                                  specs as created.
     UNIT=(L)LU8(WRITE,CLOSE)             - Job file (Signon+scratch)
                                  Opened in SIGNON
```

```
*************************************************************************
MODULE  : SUBR CHK_FO1                    SOURCE FILE: NFODL.F77
FUNCTION:  CHECKS NFODL SCREEN FOR VALID ENTRYS AND PROCESSING LOGIC
*************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN   FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      DATE                 BAD
    FUNCTIONS REFERENCED:
      CTOI                 IEOS                 ISNUM
      INDEX


*************************************************************************
MODULE  : SUBR NFWDL                      SOURCE FILE: NFWDL.F77
FUNCTION:  GETS NFWDL DATA FETCH OPTIONS
*************************************************************************
    REFERENCING ROUTINES:
      NFWDL_MENU
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN      FC_FAST.INC
    SUBROUTINES REFERENCED:
      SCR_CLEAR_SCREEN       SCR_DATA_ENTRY         MAKE_NFWDL
      NFWDL_DEFAULTS         QUE                    SCRAM


*************************************************************************
MODULE  : SUBR MAKE_NFWDL                 SOURCE FILE: NFWDL.F77
FUNCTION:  GENERATES THE FCCC NFWDL JCL STREAM
*************************************************************************
    REFERENCING ROUTINES:
      NFWDL
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 R)
    SUBROUTINES REFERENCED:
      SIGNON               GETDAT2
    FUNCTIONS REFERENCED:
      IEOS
    FILES USED:
      UNIT=(L)LU8(WRITE,CLOSE)   - Job file (opened in SIGNON)
```

```
*************************************************************************
MODULE  : SUBR NFWDL_DEFAULTS              SOURCE FILE: NFWDL.F77
FUNCTION:  LOADS NFWDL DEFAULT VALUES (HARDWIRED)
*************************************************************************
    REFERENCING ROUTINES:
      NFWDL
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE LOG R, VARIABLE I*2 R,
    ARRAY CHAR*1 S)
    FUNCTIONS REFERENCED:
      IEOS                INDEX
    FILES USED:
      UNIT=(L)LU8(OPEN,READ,CLOSE)   - Defaults from existing runstream
                                 Not currently used...


*************************************************************************
MODULE  : SUBR CHK_FW1                     SOURCE FILE: NFWDL.F77
FUNCTION:  CHECKS NFWDL DATA SCREEN FOR VALID ENTRY/PROCESSING LOGIC
*************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      CTOI                YES                ISNUM
      INDEX


*************************************************************************
MODULE  : SUBR NFWDL_LIST                  SOURCE FILE: NFWDL.F77
FUNCTION:  GENERATES THE FCCC, NFWDL 'LISTFILES' JCL STREAM
*************************************************************************
    REFERENCING ROUTINES:
      NFWDL_MENU
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    INCLUDE FILES USED:
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM             FC_COMM_C
    SUBROUTINES REFERENCED:
      SIGNON              QUE
    FILES USED:
      UNIT=8(WRITE,CLOSE)                - Job file, opened in SIGNON
```

```
*************************************************************************
MODULE  :  SUBR NFWDL_INV                    SOURCE FILE: NFWDL.F77
FUNCTION:  GETS THE TAPE LIBRARY INVENTORY SPECIFIATIONS
*************************************************************************
    REFERENCING ROUTINES:
      NFWDL_MENU
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN      FC_FAST.INC
    SUBROUTINES REFERENCED:
      SCR_CLEAR_SCREEN        SCR_DATA_ENTRY          MAKE_NFWDL_INV
      QUE                     SCRAM


*************************************************************************
MODULE  :  SUBR MAKE_NFWDL_INV               SOURCE FILE: NFWDL.F77
FUNCTION:  GENERATES THE FCCC, NFWDL 'INVENTORY' JCL STEAM
*************************************************************************
    REFERENCING ROUTINES:
      NFWDL_INV
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 AR)
    SUBROUTINES REFERENCED:
      SIGNON
    FUNCTIONS REFERENCED:
      IEOS
    FILES USED:
      UNIT=(L)LU8(WRITE,CLOSE)          - Job file, opened in SIGNON


*************************************************************************
MODULE  :  SUBR CHK_FWI                      SOURCE FILE: NFWDL.F77
FUNCTION:  CHECKS THE NFWDL, INVENTORY DATA SCREEN FOR PROCESSING LOGIC
*************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    SUBROUTINES REFERENCED:
      BAD
```

```
*******************************************************************************
MODULE  :  SUBR FIRDAT                    SOURCE FILE: FIRDAT.F77
FUNCTION:  CONTROLS THE FIRDAT STREAM GENERATION
*******************************************************************************
    REFERENCING ROUTINES:
      FIRDAT_MENU
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*32 ASR, VARIABLE LOG A)
    INCLUDE FILES USED:
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
      STUFF
    SUBROUTINES REFERENCED:
      LEAD1                MAKE_FIRDAT          SCR_CLEAR_SCREEN
      QUE                  LEAD2                LEAD3
      LEAD4                SCRAM


*******************************************************************************
MODULE  :  SUBR LEAD1                     SOURCE FILE: FIRDAT.F77
FUNCTION:  GETS LEAD CARD ONE SPECS
*******************************************************************************
    REFERENCING ROUTINES:
      FIRDAT
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      FIRDAT_DEF           SCR_CLEAR_SCR        SCR_DATA_ENTRY
      DUMP


*******************************************************************************
MODULE  :  SUBR LEAD2                     SOURCE FILE: FIRDAT.F77
FUNCTION:  GETS LEAD CARD2 SPECS
*******************************************************************************
    REFERENCING ROUTINES:
      FIRDAT
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      FIRDAT_DEF           SCR_CLEAR_SCR        SCR_DATA_ENTRY
      DUMP
```

```
********************************************************************************
MODULE  :  SUBR LEAD3                    SOURCE FILE: FIRDAT.F77
FUNCTION:  GETS LEAD CARD 3 (SEASON) SPECS
********************************************************************************
    REFERENCING ROUTINES:
      FIRDAT
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      FIRDAT_DEF           SCR_CLEAR_SCR         SCR_DATA_ENTRY
      DUMP


********************************************************************************
MODULE  :  SUBR LEAD4                    SOURCE FILE: FIRDAT.F77
FUNCTION:  GETS LEAD CARD 4 (FIRINF) SPECS
********************************************************************************
    REFERENCING ROUTINES:
      FIRDAT
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN     FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      FIRDAT_DEF           SCR_CLEAR_SCR         SCR_DATA_ENTRY
      DUMP


********************************************************************************
MODULE  :  SUBR DUMP                     SOURCE FILE: FIRDAT.F77
FUNCTION:  DUMPS CURRENT LEAD CARD SPECS INTO CHARACTER HOLDING ARRAY
********************************************************************************
    REFERENCING ROUTINES:
      LEAD1              LEAD2              LEAD3
      LEAD4
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE LOG R, VARIABLE INT R,
      VARIABLE INT AR, VARIABLE I*2 R, ARRAY CHAR*1 R)
    INCLUDE FILES USED:
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    FUNCTIONS REFERENCED:
      INT2CHAR             RJ                 POINT
      ISNUM              INDEX
```

```
*************************************************************************
MODULE  : CHAR*(*) FUNC RJ              SOURCE FILE: FIRDAT.F77
FUNCTION:  RIGHT JUSTIFIES AN INTEGER IN A STRING FIELD
*************************************************************************
    REFERENCING ROUTINES:
      DUMP
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 AR, VARIABLE I*2 R)
    FUNCTIONS REFERENCED:
      IEOS              LEN

*************************************************************************
MODULE  : CHAR*(*) FUNC POINT           SOURCE FILE: FIRDAT.F77
FUNCTION:  PUTS A DECIMAL POINT IN A STRING FIELD
*************************************************************************
    REFERENCING ROUTINES:
      DUMP
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 AR, VARIABLE I*2 R,
      VARIABLE I*2 R)
    FUNCTIONS REFERENCED:
      IEOS              LEN


*************************************************************************
MODULE  : SUBR MAKE_FIRDAT              SOURCE FILE: FIRDAT.F77
FUNCTION:  GENERATES THE FCCC, FIRDAT JCL STREAM
*************************************************************************
    REFERENCING ROUTINES:
      FIRDAT
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE LOG R, VARIABLE INT AR)
    INCLUDE FILES USED:
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM           FC_COMM_C
    SUBROUTINES REFERENCED:
      SIGNON            GETDAT2           SORT_LEAD
    FUNCTIONS REFERENCED:
      IEOS
    FILES USED:
      UNIT=8(WRITE,CLOSE)                   - Job File, opened in SIGNON


*************************************************************************
MODULE  : SUBR SORT_LEAD                SOURCE FILE: FIRDAT.F77
FUNCTION:  SORTS THE FIRDAT STATIONS AND RESETS THE VALUE OF THE SEQUENCE
*************************************************************************
    REFERENCING ROUTINES:
        MAKE_FIRDAT
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY INT SR, VARIABLE INT R,
      ARRAY INT SR)
    FUNCTIONS REFERENCED: INT
```

```
**************************************************************************
MODULE  : SUBR FIRDAT_DEF                SOURCE FILE: FIRDAT.F77
FUNCTION:  SETS FIRDAT DEFAULT VALUES (HARDWIRED)
**************************************************************************
    REFERENCING ROUTINES:
      LEAD1              LEAD2              LEAD3
      LEAD4
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE INT R, VARIABLE LOG R,
      VARIABLE I*2 R, ARRAY CHAR*1 S, VARIABLE INT R)
    INCLUDE FILES USED:
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM            FC_COMM_C
    FUNCTIONS REFERENCED:
      INT2CHAR           CTOI


**************************************************************************
MODULE  : SUBR CHK_FD1                   SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS LEAD1 DATA SCREEN FOR VALID ENTRY AND PROCESSING LOGIC
**************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    COMMON BLOCKS PRESENT:
      STUFF
    SUBROUTINES REFERENCED:
      BAD                CHK_MOD            CHK_SLOPE
      CHK_HERB           CHK_SHRUB          CHK_CLIM
    FUNCTIONS REFERENCED:
      CTOI               YES                ISNUM
      INDEX


**************************************************************************
MODULE  : SUBR CHK_FD2                   SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS LEAD2 DATA SCREEN FOR VALID ENTRY AND PROCESSING LOGIC
**************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    SUBROUTINES REFERENCED:
      BAD                CHK_MOD            CHK_SLOPE
      CHK_HERB           CHK_SHRUB          CHK_CLIM
    FUNCTIONS REFERENCED:
      CTOI               ISNUM              INDEX
```

```
*******************************************************************************
MODULE  :  SUBR CHK_FD3                    SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS LEAD3 DATA SCREEN FOR VALID ENTRY AND PROCESSING LOGIC
*******************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      CTOI              MOD               YES
      ISNUM              INDEX


*******************************************************************************
MODULE  :  SUBR CHK_FD4                    SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS LEAD4 DATA SCREEN FOR VALID ENTRY AND PROCESSING LOGIC
*******************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 ASR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      CTOI              ISNUM              INDEX


*******************************************************************************
MODULE  :  SUBR CHK_MOD                    SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS FOR VALID FUEL MODEL ENTRY
*******************************************************************************
    REFERENCING ROUTINES:
      CHK_FD1
      CHK_FD2
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 A, VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      INDEX
```

```
*******************************************************************************
MODULE  : SUBR CHK_SLOPE                SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS FOR VALID SLOPE ENTRY
*******************************************************************************
    REFERENCING ROUTINES:
      CHK_FD1           CHK_FD2
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 A, VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      INDEX


*******************************************************************************
MODULE  : SUBR CHK_CLIM                 SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS FOR VALID CLIMATE CLASS ENTRY
*******************************************************************************
    REFERENCING ROUTINES:
      CHK_FD1           CHK_FD2
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 A, VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      INDEX


*******************************************************************************
MODULE  : SUBR CHK_HERB                 SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS FOR VALID HERBACEOUS TYPE ENTRY
*******************************************************************************
    REFERENCING ROUTINES:
      CHK_FD1           CHK_FD2
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 A, VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      INDEX


*******************************************************************************
MODULE  : SUBR CHK_SHRUB                SOURCE FILE: FIRDAT.F77
FUNCTION:  CHECKS FOR VALID SHRUB TYPE ENTRY
*******************************************************************************
    REFERENCING ROUTINES:
      CHK_FD1           CHK_FD2
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 A, VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      INDEX
```

```
*******************************************************************************
MODULE  : LOG FUNC ANY2CLEAN                SOURCE FILE: UTS.F77
FUNCTION:  DETERMINES IF THERE ARE ANY FILES IN THE DEFAULT FCCC RETURN
FOLDER
*******************************************************************************
    REFERENCING ROUTINES:
      SET_CLEAN
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      CLI
    FUNCTIONS REFERENCED:
      IEOS                INDEX
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE)          - Scratch file; result of CLI FILESTAT


*******************************************************************************
MODULE  : LOG FUNC ANY2SEND                 SOURCE FILE: UTS.F77
FUNCTION:  DETERMINES IF THERE ARE ANY FILES WITH (.FCC) EXTENSION IN CURRENT
*******************************************************************************
    REFERENCING ROUTINES:
      SET_QUE
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    SUBROUTINES REFERENCED:
      CLI
    FUNCTIONS REFERENCED:
      INDEX
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE)          - Scratch file; result of CLI FILESTAT


*******************************************************************************
MODULE  : SUBR APPENDC                      SOURCE FILE: UTS.F77
FUNCTION:  APPENDS CHARACTERS TO A STRING
*******************************************************************************
    REFERENCING ROUTINES:
      SIGNON              CHK_PATH              SET_CLEAN
      SET_QUE
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 AS, VARIABLE CHAR*1 R,
      VARIABLE INT R)
    FUNCTIONS REFERENCED:
      IEOS
```

```
*************************************************************************
MODULE  : SUBR BAD                      SOURCE FILE: UTS.F77
FUNCTION:  PRINTS ERROR MESSAGE AND SETS SCR_SFLG TO ' '
*************************************************************************
    REFERENCING ROUTINES:
      CHK_F01           CHK_FW1           CHK_FWI
      CHK_FD1           CHK_FD2           CHK_FD3
      CHK_FD4           CHK_MOD           CHK_SLOPE
      CHK_CLIM          CHK_HERB          CHK_SHRUB
      CHK_PATH          CHK_CLN           CHL_QUE
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 S, VARIABLE CHAR*1 A)
    SUBROUTINES REFERENCED:
      SCR_DISPLAY_MESSAGE


*************************************************************************
MODULE  : SUBR CHK_CLN                  SOURCE FILE: UTS.F77
FUNCTION:  CHECKS SET_CLEAN DATA SCREEN VALUES FOR VALIDITY AND PROCESS
LOGIC
*************************************************************************
    REFERENCING ROUTINES:
        SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 SR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN   FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM           FC_COMM_C
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      CTOI              IEOS              ISNUM


*************************************************************************
MODULE  : SUBR CHK_PATH                 SOURCE FILE: UTS.F77
FUNCTION:  CHECKS ENTRIES FOR VALID FCCC FILE STRUCTURE, AND DG PATH VALUES
*************************************************************************
    REFERENCING ROUTINES:
        SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 SR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN
    SUBROUTINES REFERENCED:
      BAD               SCAN              SCR_DISPLAY_MESSAGE
      APPENDC
    FUNCTIONS REFERENCED:
      CTOI              IEOS              ISNUM
      INDEX
```

```
*******************************************************************************
MODULE  :  SUBR CHK_QUE                    SOURCE FILE: UTS.F77
FUNCTION:  CHECKS SET_QUE DATA SCREEN ENTRIES FOR VALIDITY AND PROCESS
CONTROL
*******************************************************************************
    REFERENCING ROUTINES:
      SCRUSERCHECK
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 SR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN   FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      BAD
    FUNCTIONS REFERENCED:
      CTOI                 IEOS                 ISNUM


*******************************************************************************
MODULE  :  SUBR CLEAN                      SOURCE FILE: UTS.F77
FUNCTION:  STRIPS ALL FCCC JCL FROM RETURNED DATA FILE AND MAKES USEABLE
DATA
*******************************************************************************
    REFERENCING ROUTINES:
      SET_CLEAN
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R, VARIABLE CHAR*1 R,
      VARIABLE CHAR*1 R, VARIABLE INT SR, VARIABLE INT SR,
          VARIABLE LOG R, VARIABLE CHAR*1 S)
    SUBROUTINES REFERENCED:
      SCR_DISPLAY_MESSAGE
    FUNCTIONS REFERENCED:
      IEOS                 INDEX
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE)  -- FILE TO BE CLEANED
      UNIT=21(OPEN,WRITE,CLOSE) -- NEW DATA FILE
```

```
*************************************************************************
MODULE  : SUBR CLEAN_INDEX                SOURCE FILE: UTS.F77
FUNCTION:  GIVES AN INDEX OF FILES IN THE DEFAULT FCCC RETURN FOLDER
*************************************************************************
    REFERENCING ROUTINES:
      SCRUSERINDEX
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 SR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN   SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM        FC_COMM_C
    SUBROUTINES REFERENCED:
      CLI                SCR_DATA_ENTRY         SCRAM
      SCR_DISPLAY_MESSAGE
    FUNCTIONS REFERENCED:
      CTOI               IEOS                INT2CHAR
      INDEX
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE)          - Scratch file; result of CLI FILESTAT


*************************************************************************
MODULE  : SUBR CLI                        SOURCE FILE: UTS.F77
FUNCTION:  INITIATIES A ONE-COMMAND SON PROCESS FROM WITHIN FCFAST
*************************************************************************
    REFERENCING ROUTINES:
      GET_HOST           GET_WHO            GET_DIR
      SET_CLEAN          ANY2CLEAN          CLEAN_INDEX
      SET_QUE            ANY2SEND           QUE_INDEX
      QUE
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R, VARIABLE INT S)


*************************************************************************
MODULE  : INT FUNC CTOI                   SOURCE FILE: UTS.F77
FUNCTION:  CONVERTS CHARACTER STRING TO INTEGER
*************************************************************************
    REFERENCING ROUTINES:
      MAKE_NFODL         CHK_FO1            CHK_FW1
      FIRDAT_DEF         CHK_FD1            CHK_FD2
      CHK_FD3            CHK_FD4            CHK_PATH
      CLEAN_INDEX        CHK_CLN            CHK_QUE
      QUE_INDEX
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 AR)
    FUNCTIONS REFERENCED:
      IEOS
```

```
*************************************************************************
MODULE  : SUBR DEFAULTS                    SOURCE FILE: UTS.F77
FUNCTION:  GETS/SETS DEFAULTS FOR/FROM USER'S CONFIGURATION FILE
*************************************************************************
    REFERENCING ROUTINES:
      SET_JOB
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*32 AR, VARIABLE CHAR*1 R,
      ARRAY CHAR*1 SR)
    INCLUDE FILES USED:
      SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM              FC_COMM_C
    SUBROUTINES REFERENCED:
      SCR_CLEAR_SCREEN      SCR_DATA_ENTRY         SCRAM
      SCR_DISPLAY_MESSAGE
    FUNCTIONS REFERENCED:
      GET_HOST
    FILES USED:
      UNIT=20(OPEN,READ,WRITE,REWND,CLOSE)        - Configuration file


*************************************************************************
MODULE  : SUBR ERROR                       SOURCE FILE: UTS.F77
FUNCTION:  LOGS A TRAPPED MESSAGE TO THE TERMINAL
*************************************************************************
    REFERENCING ROUTINES:
      DECODE
    PRIMARY AGRUMENT DESCRIPTIONS: (VARIABLE INT S, VARIABLE CHAR*(*),
      VARIABLE CHAR*(*)
    SUBROUTINES REFERENCED:
      SCR__W
    'PAUSE' STATEMENT IS PRESENT


*************************************************************************
MODULE  : SUBR GETDAT2                     SOURCE FILE: UTS.F77
FUNCTION:  GENERATES FCCC, NFWDL GETDATA2 JCL STREAM
*************************************************************************
    REFERENCING ROUTINES:
      MAKE_NFWDL           MAKE_FIRDAT
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*15 R, VARIABLE CHAR*15 )
    SUBROUTINES REFERENCED:
      DATE              SRTSTN              SCR_DISPLAY_WARNING
    FUNCTIONS REFERENCED:
      IEOS
    FILES USED:
      UNIT=(L)LU7(OPEN,READ,CLOSE)    - NFWDL.NDX File
      UNIT=(L)LU8(WRITE)              - Job file; opened in SIGNON
```

```
*************************************************************************
MODULE  :  CHAR*(*) FUNC GET_DIR            SOURCE FILE: UTS.F77
FUNCTION:  DETERMINES CURRENT WORKING DIRECTORY
*************************************************************************
    REFERENCING ROUTINES:
      QUE_INDEX
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    SUBROUTINES REFERENCED:
      CLI                NEXT_UNIT
    FILES USED:
      UNIT=(L)VALUE(OPEN,READ,CLOSE)        - Scratch file; result of CLI DIR


*************************************************************************
MODULE  :  CHAR*(*) FUNC GET_HOST           SOURCE FILE: UTS.F77
FUNCTION:  DETERMINES CURRENT DG HOST BY CLI FUNCTION 'HOST/L=FILE'
*************************************************************************
    REFERENCING ROUTINES:
      DEFAULTS
    PRIMARY  ARGUMENT DESCRIPTIONS: (NONE)
    SUBROUTINES REFERENCED:
      CLI                NEXT_UNIT
    FILES USED:
      UNIT=(L)VALUE(OPEN,READ,CLOSE)        - Scratch file; result of CLI HOST


*************************************************************************
MODULE  :  CHAR*(*) FUNC GET_WHO            SOURCE FILE: UTS.F77
FUNCTION:  GETS CURRENT USER PROFILE NAME BYE CLI COMMAND 'WHO/L=FILE'
*************************************************************************
    REFERENCING ROUTINES:
      FC_FAST_MAIN
    PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
    SUBROUTINES REFERENCED:
      CLI
    FUNCTIONS REFERENCED:
      IEOS               INDEX
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE)          - Scratch file; result of CLI WHO
```

```
*****************************************************************************
MODULE  : INT FUNC IEOS                    SOURCE FILE: UTS.F77
FUNCTION:  RETURNS POS OF LAST NON-BLANK CHARACTER IN A STRING
*****************************************************************************
    REFERENCING ROUTINES:
      DECODE              MAKE_NFODL          CHK_FO1
      MAKE_NFWDL          NFWDL_DEFAULTS      MAKE_NFWDL_INV
      RJ                  POINT               MAKE_FIRDAT
      CTOI                APPENDC             ISNUM
      SIGNON              SET_JOB             GET_WHO
      CHK_PATH            GETDAT2             SET_CLEAN
      ANY2CLEAN           CLEAN_INDEX         CHK_CLN
      CLEAN               CHK_QUE             QUE_INDEX
      QUE
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R)
    FUNCTIONS REFERENCED:
      LEN


*****************************************************************************
MODULE  : CHAR*(*) FUNC INT2CHAR           SOURCE FILE: UTS.F77
FUNCTION:  CONVERTS INTEGET TO CHARACTER STRING
*****************************************************************************
    REFERENCING ROUTINES:
      DUMP                FIRDAT_DEF          SET_CLEAN
      CLEAN_INDEX         QUE_INDEX
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE INT R)


*****************************************************************************
MODULE  : LOG FUNC ISNUM                   SOURCE FILE: UTS.F77
FUNCTION:  CHECK STRING TO DETERMINE IF IT AN INTEGER NUMBER (0123456789)
*****************************************************************************
    REFERENCING ROUTINES:
      CHK_F01             CHK_FW1             CHK_FD1
      CHK_FD2             CHK_FD3             CHK_FD4
      CHK_PATH            CHK_CLN             CHL_QUE
      DUMP
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 AR)
    FUNCTIONS REFERENCED:
      IEOS                ICHAR
```

```
*****************************************************************************
MODULE  : SUBR NEXT_UNIT                    SOURCE FILE: UTS.F77
FUNCTION:  FINDS NEXT AVAILABLE I/O UNIT NUMBER
*****************************************************************************
    REFERENCING ROUTINES:
      GET_HOST              GET_DIR

    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE INT SR, VARIABLE INT S)
    FILES USED:
      UNIT=(D)FILE(INQRE)


*****************************************************************************
MODULE  : SUBR QUE                          SOURCE FILE: UTS.F77
FUNCTION:  QUES A FILE FOR SUBMISSION TO FCCC
*****************************************************************************
    REFERENCING ROUTINES:
      SET_QUE               NFWDL                 NFODL
      FIRDAT               NFWDL_LIST             NFWDL_INV
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R, VARIABLE CHAR*1 R)
    SUBROUTINES REFERENCED:
      SCR__W                CLI
    FUNCTIONS REFERENCED:
      IEOS                 INDEX
    'PAUSE' STATEMENT IS PRESENT


*****************************************************************************
MODULE  : SUBR QUE_INDEX                    SOURCE FILE: UTS.F77
FUNCTION:  LISTS ALL FILES WITH (.FCC) EXTENSION IN WORKING DIRECTORY
*****************************************************************************
    REFERENCING ROUTINES:
      SCRUSERINDEX
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY CHAR*1 SR)
    INCLUDE FILES USED:
      SCR_SUBROUTINE.F77.IN   SCR_DATA_ENTRY.F77.IN   SCR_OFFSETS.F77.IN
      FC_FAST.INC
    COMMON BLOCKS PRESENT:
      FC_COMM               FC_COMM_C
    SUBROUTINES REFERENCED:
      CLI                 SCR_DATA_ENTRY        SCRAM
      SCR_DISPLAY_MESSAGE
    FUNCTIONS REFERENCED:
      CTOI                IEOS                GET_DIR
      INT2CHAR              INDEX
    FILES USED:
      UNIT=20(OPEN,READ,CLOSE)          - Scratch file, result of CLI FILESTAT
```

```
*******************************************************************************
MODULE : SUBR SCAN                      SOURCE FILE: UTS.F77
FUNCTION: SCANS A STRING FOR THE OCCURRENCE OF A SPECIFIED CHARACTER
*******************************************************************************
   REFERENCING ROUTINES:
      SIGNON          CHECK_PATH
   PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R, VARIABLE INT R,
     VARIABLE INT R, VARIABLE CHAR*1 R, VARIABLE INT R, VARIABLE INT S,
     VARIABLE INT S, VARIABLE INT R)


*******************************************************************************
MODULE : SUBR SCRAM                     SOURCE FILE: UTS.F77
FUNCTION: TERMINATE PROGRAM ON CONTROL-SHIFT F1
*******************************************************************************
   REFERENCING ROUTINES:
     FC_FAST_MAIN        FIRDAT_MENU         NFWDL_MENU
     NFODL_MENU          FIRDAT              SIGNON
     SET_JOB             DEFAULTS            SET_CLEAN
     CLEAN_INDEX         SET_QUE             QUE_INDEX
   PRIMARY ARGUMENT DESCRIPTIONS: (NONE)
   SUBROUTINES REFERENCED:
     SCR_CLEAR_SCREEN    SCR_TERM            EXIT
   'STOP' STATEMENT IS PRESENT


*******************************************************************************
MODULE : SUBR SET_CLEAN                 SOURCE FILE: UTS.F77
FUNCTION: CONTROLS UTILITY PROCESSING FOR RETURNED FCCC PRINT FILES
*******************************************************************************
   REFERENCING ROUTINES:
     FIRDAT_MENU         NFODL_MENU          NFWDL_MENU
   PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*32 AR, VARIABLE CHAR*1 A)
   INCLUDE FILES USED:
     SCR_DATA_ENTRY.F77.IN  SCR_OFFSETS.F77.IN   FC_FAST.INC
   COMMON BLOCKS PRESENT:
     FC_COMM             FC_COMM_C
   SUBROUTINES REFERENCED:
     SCR_DISPLAY_WARNING  SCR_DATA_ENTRY      SCRAM
     CLEAN                SCR__W              APPENDC
     SCR_DISPLAY_MESSAGE  CLI
   FUNCTIONS REFERENCED:
     INT2CHAR             ANY2CLEAN           IEOS
   FILES USED:
     UNIT=20(OPEN,READ,CLOSE)        - Configuration file
```

```
*****************************************************************************
MODULE : SUBR SET_JOB                    SOURCE FILE: UTS.F77
FUNCTION: SETS UP FCCC JOB PARAMETERS (PRIORITY, USER, ACCOUNT, RETURN...)
*****************************************************************************
   REFERENCING ROUTINES:
     SIGNON
   PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*32 AR, ARRAY CHAR*50 S,
     VARIABLE CHAR*1 R)
   INCLUDE FILES USED:
     SCR_DATA_ENTRY.F77.IN  SCR_OFFSETS.F77.IN     FC_FAST.INC
   COMMON BLOCKS PRESENT:
     FC_COMM              FC_COMM_C
   SUBROUTINES REFERENCED:
     DEFAULTS             SCR_CLEAR_SCREEN      SCR_DATA_ENTRY
     SCRAM              SCR_DISPLAY_MESSAGE
   FUNCTIONS REFERENCED:
     IEOS               LEN


*****************************************************************************
MODULE : SUBR SET_QUE                    SOURCE FILE: UTS.F77
FUNCTION: CONTROLS UTILITY PROCESSING FOR FCCC JOB FILES
*****************************************************************************
   REFERENCING ROUTINES:
     FIRDAT_MENU          NFODL_MENU          NFWDL_MENU
     UTIL_MENU
   PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*32 AR, VARIABLE CHAR*1 R)
   INCLUDE FILES USED:
     SCR_DATA_ENTRY.F77.IN  SCR_OFFSETS.F77.IN     FC_FAST.INC
   COMMON BLOCKS PRESENT:
     FC_COMM              FC_COMM_C
   SUBROUTINES REFERENCED:
     SCR_DISPLAY_WARNING    SCR_DATA_ENTRY        SCRAM
     QUE                APPENDC             SCR_DISPLAY_MESSAGE
     SCR__W               CLI
   FUNCTIONS REFERENCED:
     ANY2SEND
```

```
*****************************************************************************
MODULE  : SUBR SIGNON                    SOURCE FILE: UTS.F77
FUNCTION:  GENERATES FCC SIGNON JCL (@APPLICATION, @RUN, @NETSYM)
*****************************************************************************
    REFERENCING ROUTINES:
      MAKE_NFODL          MAKE_NFWDL          NFWDL_LIST
      MAKE_NFWDL_INV      MAKE_FIRDAT
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 A, VARIABLE LOG S)
    SUBROUTINES REFERENCED:
      SET_JOB             SCRAM               APPENDC
      SCAN
    FUNCTIONS REFERENCED:
      IEOS                INDEX
    FILES USED:
      UNIT=(L)LU8(OPEN,WRITE)   - Job file, name passed in)


*****************************************************************************
MODULE  : SUBR SRTSTN                    SOURCE FILE: UTS.F77
FUNCTION:  SORTS NFWDL STATIONS IN ASCENDING ORDER
*****************************************************************************
    REFERENCING ROUTINES:
      GETDAT2
    PRIMARY ARGUMENT DESCRIPTIONS: (ARRAY INT SR, VARIABLE INT R,
      ARRAY INT SR, ARRAY INT SR)
    FUNCTIONS REFERENCED:
      INT


*****************************************************************************
MODULE  : LOG FUNC YES                   SOURCE FILE: UTS.F77
FUNCTION:  CHECKS STRING FOR YES/NO (Y/N) VALUE.
*****************************************************************************
    REFERENCING ROUTINES:
      CHK_FW1             CHK_FD1             CHK_FD3
    PRIMARY ARGUMENT DESCRIPTIONS: (VARIABLE CHAR*1 R)
    FUNCTIONS REFERENCED:
      INDEX
```

11/13/90

FCFAST: Fort Collins Fire Access Software

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For at least a decade, fire managers have recognized how much the computer can accomplish in helping them to plan. No one would dispute, however, that computer use can be complicated and time-consuming--especially when a manager doesn't use a particular software package very often. The Fort Collins Fire Access Software (FCFAST) is a utility designed to assist the casual user of the USDA, Fort Collins Computer Center (FCCC) in accessing two databases and one software package often used in fire management planning. It removes the burden of remembering (or learning) FCCC syntax and using a text editor to put values in appropriate columns on ordered records for every application.

The databases FCFAST accesses are:

1. NFWDL - The National Fire Weather Data Library (Furman and Brink 1975), and
2. NFODL - The National Fire Occurrence Data Library (Yancik and Roussopoulos 1982).

FCFAST does not perform analysis on datasets from a library--it extracts and optionally downloads them to a remote site where a fire manager can access the information.

The other function of FCFAST is to generate FIREFAMILY (FIRDAT, SEASON, FIRINF) runs at FCCC, and optionally, create "passing files" when the fire manager needs them. FCFAST will generate either 1978 (Main, Straub, and Paananen 1982) or 1988 (Main, Paananen, and Burgan 1990) runs of FIREFAMILY. In the same way that datasets are extracted from a library, FIREFAMILY's passing files may be downloaded to the fire manager's local computer.

PROGRAM STRUCTURE

FCFAST is menu-driven and uses data entry screens to solicit required information, which is checked for validity. There is also on-line context sensitive help. The on-line help is not intended to replace the User's Guides for the systems that FCFAST accesses--a basic knowledge of the required information is expected. However, between the on-line help, the input prompt for each input field, and error messages on invalid entries, users can quickly construct error-free runstreams for transmission to FCCC.

IMPLEMENTATION

There are two versions of FCFAST. One is for use on the Forest Service's Data General Computers. The other is a Personal Computer (PC) version. FCFAST was written using the Forest Service Application Toolkit (FSAT-Screen Utilities Library) to achieve a CEO-like format (menus, data entry screens, and function keys). The PC version uses the PCFSAT (Aviation & Fire Management, Pacific Northwest Research Station, Seattle, Washington) to achieve a similar interface.

Forest Service Data General Systems

On the Forest Service's Data General system, FCFAST is a CEO integrated program located at the staff level of the Information Systems (IS) area. It

automatically submits runstreams to FCCC. Users are notified by IS when jobs are sent to and received from FCCC.

Personal Computers

The PC version creates runstreams for transmission to FCCC over a telephone modem. Completed runs are "captured" on the PC. If an NFWDL data file was downloaded, the captured file may be processed for analysis by PC-based software such as PCFIRDAT (Blanchard, 1989). The PC version requires no specific communication package--only that the software be able to transmit a PC file to a remote computer and log screen activity to a PC file.

PROGRAM AVAILABILITY

FCFAST is available through the USDA, Forest Service, Software Reference Center (SRC) to Forest Service users (both the DG and PC versions).

The PC version of FCFAST can also be obtained from the following source:

Forestry Resources Systems Institute
122 Helton Court
Florence, AL 35630
205-767-0250

SUPPORT

FCFAST is supported by the Forest Service, Washington Office, Fire and Aviation Management, (406) 329-4950, FTS 584-4950.

References

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Furman, R. William; and Brink, Glen E. 1975. The national fire weather data library: what it is and how to use it. Gen. Tech. Rep. RM-19. Fort Collins CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 8 p.

Main, William A.; Straub, Robert J., and Paananen, Donna M. 1982. FIREFAMILY: Fire planning with historic weather data. Gen. Tech. Rep. NC-73. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station; 31 p.

Main, William A.; Paananen, Donna M., and Burgan, Robert E. 1990. FIREFAMILY 1988. Gen. Tech. Rep. NC-138. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 35 p.

Yancik, Richard F.; and Roussopoulos, Peter J. 1982. User's guide to the national fire occurrence data library. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 25 p.

ACKNOWLEDGMENT

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Fort Collins Fire Access Software

Program Notes - DG Version

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Missoula, Montana
November 1990

Fort Collins Fire Access Software (FCFAST) is a utility designed to assist the casual user of the USDA, Fort Collins Computer Center (FCCC) in accessing two databases and one software package often used in fire management planning. It removes the burden of remembering (or learning) FCCC syntax and using a text editor to put values in appropriate columns on ordered records for each application. FCFAST is supported by USDA, Forest Service, Washington Office, Fire and Aviation Management (phone 406-329-4950; FTS 584-4950).

These notes were written under the assumption that you are familiar with the information in the referenced publications and the file structures of your computer. FCFAST is menu driven and easy to use. There is on-line help available in the program, and the information here is for reference on specific areas. The program is easier to use than these notes are to read. Refer to them only if you have trouble with the program.

The databases FCFAST accesses are:

1. NFWDL - The National Fire Weather Data Library (Furman and Brink, 1975), and

2. NFODL - The National Fire Occurrence Data Library (Yancik and Roussopoulos, 1982).

FCFAST does not perform analysis on datasets from a library-- it extracts, and optionally, downloads them to a remote site where they may be used locally.

The other function of FCFAST is to generate FIREFAMILY (FIRDAT, SEASON, FIRINF) runs at FCCC, and optionally, create 'passing files.' FCFAST will generate either 1978 (Main and others 1982), or 1988 (Main and others, 1990) runs of FIREFAMILY. Like datasets extracted from a library, passing files may be downloaded to a host computer for local use.

Implementation:

There are two versions of FCFAST. One is for use on the Forest Service, Data General Computers. The other is a Personal Computer (PC) version. FCFAST was written using the Forest Service Application Toolkit (FSAT-Screen Utilities Library) to achieve a CEO-like format (menus, data entry screens, and function keys). The PC version uses the PC_FSAT (Pacific Northwest Research Station, Seattle, Washington) to achieve a similar interface. These notes describe the Data General Version.

Forest Service Data General Systems:

On the Forest Service's Data General system, FCFAST is a CEO integrated program located at the staff level of the Information Systems (IS) area. It automatically submits runstreams (via the QFCCC utility) to FCCC. Returned FCCC print files are stashed in the FCFILES folder of a user-specified STAFF-DRAWER on a specified host computer. Users are notified by IS when jobs are sent to and received from FCCC.

PROGRAM STRUCTURE:

FCFAST is menu-driven, and uses data entry screens to solicit required information, which is checked for validity. There is on-line, context sensitive help for every menu and for the first entry field of each input screen. The on-line help is not intended to replace the User's Guides for the systems that FCFAST accesses-- you are expected to have a basic knowledge of the information required. However, between the on-line help, the input prompt associated with each input field, and error messages on invalid entries, you should be able to quickly construct error-free runstreams for transmission to FCCC.

The Main Menu of FCFAST provides 4 options:

1. FIRDAT (Firefamily) Activities,
2. NFDWL Activities,
3. NFODL Activities, and
4. Program Utilities.

Main menu options 1, 2, and 3 provide access to FCCC. Functions within each module are similar. You may:

1. Build runstreams. You specify whether to send it to FCCC immediately, at a specified time, or not at all.

2. Perform utility operations on existing runstreams. You may:
   - SEND - Send to FCCC (via QFCCC),
   - VIEW - View (via VIEW),
   - EDIT - Edit (via SED),
   - PRINT - Print (via QPRINT), or
   - DELETE - Delete (via DELETE).

3. Perform utility operations on return FCCC print files. You may:
   - VIEW - View (via VIEW),
   - PRINT - Print (via QPRINT),
   - CLEAN - Prepare a data file from a downloaded FCCC file, or
   - DELETE - Delete a print file.
   - RENAME - Rename a returned print file.

Three topics common to these functions (runstreams, job set-up, and preparing downloaded data files) are discussed first.

RUNSTREAMS

A runstream is a text file containing everything required to initiate and complete a run at FCCC. Runstreams may be edited prior to sending to FCCC if needed. FCFAST uses default filenames for creating runstreams. They are:

FIRDAT.FCC for FIRDAT runstreams,
GET_NFWD.FCC for NFWDL runstreams, and
GET_NFOD.FCC for NFODL runstreams.

Runstreams reside in the working directory they are created in. Existing runstreams are always overwritten, so attention may be required when creating runstreams that aren't immediately sent to FCCC. For example, if you create three FIRDAT runstreams using the default name and send them to FCCC at any time other than immediately, the same file would be sent three times. The file would contain the specifications of the last job created. The same problem will occur if several people use the program out of the same directory. If either of these situations occur, you should send each runstream to FCCC immediately or preferably, give each runstream a unique name.

To send an existing runstream to FCCC use the INDEX (Shift F2) key to list files with FCC extensions in the working directory (or enter the filename directly if you know it) and then select the SEND option.

JOB SET-UP

A 'Job Set-Up' screen is displayed just before a runstream is built and contains FCCC logon information (see Option 4 below) plus three values:

1. Submit Time: When to submit a runstream to FCCC. The default is 1800 hours, but you may enter 'NOW' or a specific time.

2. FCCC Job File: File to hold new runstream. If you overwrite the default name (as described above) be sure to include an FCC extension.

3. Que Job Now?: Y - Runstream is built and immediately queued for transmission to FCCC at the submit time. N - Runstream is built but not queued.

PREPARING DOWNLOADED DATA FILES FOR LOCAL USE

Downloaded data files are included as part of the job's print file (in the FCFILES folder of the STAFF:DRAWER the job was returned to). The print file name is included in the IS message reporting a successful retrieval from FCCC. The name is a combination of the Run ID, PR$000, and a random mix of alphanumeric characters in the format 'RUNID_PR$000_ABC123.'

To prepare a data file, specify the names of the returned print file and the resulting data file. Use the INDEX (Shift F2) key to select the desired print file, then select the CLEAN option to begin the operation. You will probably want to VIEW it first to ensure it did what it was supposed to. The new data file will reside in the current working directory.

Accessing FIRDAT - Option 1

You may generate FIREFAMILY runstreams for either the 1978 (Deeming and others, 1977) or 1988 (Burgan, 1988) version of the NFDRS. The data screens are identical for both versions-- the format of the runstreams differ.

There are four data screens -- one for each 'lead card.' They are presented in the logical sequence of lead card 1 through 4. Lead cards 3 (SEASON) and 4 (FIRINF) are optional. There is one lead card 1 and one lead card 2 per station. There may be up to three SEASON and three FIRINF cards per station. Each 'lead card' screen must be 'executed' to proceed to the next. If you are running SEASON or FIRINF, FCFAST automatically continues with the next logical input screen after the third SEASON or FIRINF lead card is executed. After FIRINF input is complete, FCFAST recycles to lead card 1 for a new station.

Weather stations may be entered in any order-- FCFAST sorts them by six digit station ID number when the runstream is built. As you enter stations, FCFAST tracks them sequentially. The sequential number (1,2,..) and station name are displayed at the top of each screen, along with the lead card number. On SEASON and FIRINF lead cards, the subcard (card 1 of 3, 2 of 3, or 3 of 3) is also displayed.

If you are not using an existing passing file (the usual case), weather data is automatically fetched from the NFWDL as a part of the FIRDAT runstream.

Passing file information is requested only on the first station (sequence number 1). If you create a new, or use an existing 'passing file,' you must provide its name and you may request that it be downloaded for local use. If you create one, you may save it at FCCC past six days.

To build a FIRDAT runstream, CANCEL/EXIT from the adminstrative owner name field (field 1, lead card 1). The runstream will include the previously 'executed' station(s). If you CANCEL/EXIT from the owner field on the first station, no runstream is built and control returns to the FIRDAT menu. You may move backwards between lead cards (e.g. from card 2 to card 1) by using the previous screen function key (F3). Forward movement should always be accomplished with 'execute' (F1).

Refer to the appropriate FIRFAMILY User's guide for specific information on the contents of the specific lead cards and passing files. There is on-line help about fuel models when the cursor is on a fuel model field on lead cards one or two.

Accessing NFWDL - Option 2

There are three options in accessing the NFWDL at FCCC. You may:

1. Make a GETDATA2 runstream to generate datasets,

2. Make a LISTFILES runstream to list the stations on the NFWDL tapes, or

3. Make an INVENTORY runstream to list the contents of particular NFWDL tapes (you enter the tape names as defined in a LISTFILES run).

Option 1. GETDATA2

Select option 1 and the the NFWDL data screen is shown. Enter the station number and year specifications for up to 20 stations. If any ending year in the run is equal to the current year, the NEWYR tape is loaded. NEWYR tape is not loaded if ending year is greater than the current year. Stations may be entered in any order. Leave the station ID blank to move to the file definition section of the screen.

Station Number: Six-digit station id number. Leave blank to continue.

Begin: Year (yy) to begin data extraction. (00 to 99)

End: Year (yy) to end data extraction. (Begin to 99)

Catalog File?: Y - Create a cataloged file at FCCC. You must also specify the filename, and whether to save the file past six days. (At FCCC, files are deleted after 6 days unless @SAVE'd. It is usually cheaper to recreate weather files than store them.)

N - Do not create a cataloged file. Enter N only when downloading a file for local use and you don't want to use the data at FCCC.

Filename: FCCC filename for file you are creating. FCCC files have two parts-- the qualifier and the filename. Both are up to 12 alphanumeric characters (no special characters).

Save past 6 Days: Y - Invoke @SAVE processor. You must also must provide a 'save date' and a description of the file. N - File is automatically purged in 6 days

Download to Host: Y - Download a copy of the weather data to the host.
N - Do not download data file to host.

Execute: Y - Use current screen to build a runstream. N - Edit current screen starting at the first station.

Option 2. LISTFILES - No input required - goes right to job set-up screen.

Option 3. INVENTORY - Enter the tape name (from LISTFILES) for each tape you want an inventory of. Blank to continue, execute to generate the runstream.

Accessing NFODL - Option 3

Select build a new runstream and the NFODL input screen is displayed. NFODL runstreams are built region by region. You are responsible for knowing the numeric ADP codes for the regions/forests/districts you extract data for.

Agency: Agency code for fires to extract. If you CANCEL/EXIT the first time here, you return to the main menu. CANCEL/EXIT here any other time builds the runstream using previously executed 'region' screens.

Region: ADP code for a region.

Begin: Year (yyyy) to begin. (1970 to current year - 1)

End: Year (yyyy) to end. (Begin to current year - 1)

Forests: Forest ADP code(s) for the region. Enter a list (e.g. 1,5,8), a range (e.g. 1-5), a combined list and range (e.g. 1-5,8,11-14, 17), or ALL. If you enter anything other than ALL, you must define the districts for each forest. Data are extracted for the same years for each forest. (This differs from directly accessing NFODL without FCFAST where you may override the region specified years on the forest card.)

Districts: ADP code(s) for the desired district(s) for each specified forest. FCFAST builds the district portion of the screen based on the forest specifications (the region and forest ADP codes are displayed as part of the input field). District entry is the same as forest (list, range, combined list and range, or ALL)

Format: Format(s) for the data file(s). Valid entries are SPSS, FUEL, FPL, or QQ. (See Yancik and Roussopoulos, 1982.) You must enter at least one, you may enter more. Separate entries by a space (e.g. SPSS FPL). If you enter multiple formats and download the file, only the first format is downloaded.

Download: Y - Download a copy of the data file to the host. Remember, only the first format on multiple format runs is downloaded, although all formats are created at FCCC.

N - Do not download a copy of the data file to the host.

Execute: Y - Screen values are included in the runstream. Screen recycles for another region.

N - Edit districts on current screen.

Program Utilites - Option 4

The Program Utilities module allows you to create/modify the FCFAST configuration file. This file, FCFAST.CFG, resides in your working directory and contains default values used in the FCCC @RUN and @NETSYM commands. The default values may always be overridden.

The parameters contained in the configuration file are:

1. Run Priority. You may use L, N, P, or W. L is the highest priority and has a turn around time of about 10 minutes. N is one hour, P overnight, and W is weekend. L is the most expensive, W the least. P priority jobs usually come back within the hour.

2. Run Id: 1 to 6 alphanumeric characters, no special characters.

3. Account Number: 10 numeric characters.

4. Run Qualifer: 1 to 12 alphanumeric characters, no special characters. This defines the default 'qualifier' portion of any files created at FCCC during a run. FCFAST sets the run qualifer to the system being accessed (FIRDAT, NFWDL, or NFODL).

5. Return Host: DG address to send FCCC print file. Defaults to current host computer, but may be any valid DG address.

6. Return STAFF:DRAWER: Where to put the returned FCCC print file on the host.

   Entry of the STAFF:DRAWER is the trickiest part of using FCFAST. Enter the FULL pathname of the STAFF:DRAWER but DO NOT do not include a folder specification. The standard folder FCFILES is assumed. If FCFILES does not exist (or is full), the print file is discarded. The DRAWER characteristics must allow FCCC jobs to be stored there. The FULL pathname is required because the STAFF:DRAWER is also used to build a list of available files when preparing downloaded files for local use.

   The STAFF:DRAWER portion of the field must be 12 characters or less in length and may not contain underscores (_). The STAFF portion may contain a staff alias if one has been established in the FCCC_CONTROL file on your host. Use of the alias allows longer staff names and underscores. Consult your staff information manager for more details on staff aliases.

   Example: :BOTH:STAFF:FB:FCCCPAT

   FCFAST decodes the STAFF:DRAWER portion of this value to FB-FCCCPAT for use on the FCCC @NETSYM card. Files are automatically stashed in the FCFILES folder of FB:FCCCPAT. When preparing a downloaded data file and an index of files is requested, FCFAST uses the full pathname (:BOTH:STAFF:FB:FCCCPAT) to generate a list of available files in the FCFILES folder.

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Fort Collins Fire Access Software

Program Notes - PC Version

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Fort Collins Fire Access Software (FCFAST) is a utility designed to assist the casual user of the USDA, Fort Collins Computer Center (FCCC) in accessing two databases and one software package often used in fire management planning. It removes the burden of remembering (or learning) FCCC syntax and using a text editor to put values in appropriate columns on ordered records for each application. FCFAST is supported by USDA, Forest Service, Washingtion Office, Fire and Aviation Management (phone 406-329-4950; FTS 584-4950).

These notes were written under the assumption that you are familiar with the information in the referenced publications and the file structures of your computer. FCFAST is menu driven and easy to use. There is on-line help available in the program, and the information here is for reference on specific areas. The program is easier to use than these notes are to read. Refer to them only if you have trouble with the program.

The databases FCFAST accesses are:

1. NFWDL - The National Fire Weather Data Library (Furman and Brink, 1975), and

2. NFODL - The National Fire Occurrence Data Library (Yancik and Roussopoulos, 1982).

FCFAST does not perform analysis on datasets from a library-- it extracts, and optionally, downloads them to a remote site where they may be used locally.

The other function of FCFAST is to generate FIREFAMILY (FIRDAT, SEASON, FIRINF) runs at FCCC, and optionally, create 'passing files.' FCFAST will generate either 1978 (Main and others 1982), or 1988 (Main and others 1990) runs of FIREFAMILY. Like datasets extracted from a library, passing files may be downloaded to a host computer for local use.

Implementation:

There are two versions of FCFAST. One is for use on the Forest Service, Data General Computers. The other is a Personal Computer (PC) version. FCFAST was written using the Forest Service Application Toolkit (FSAT-Screen Utilities Library) to achieve a CEO-like format (menus, data entry screens, and function keys). The PC version uses the PC_FSAT (Pacific Northwest Research Station, Seattle, Washington) to achieve a similar interface. These notes describe the PC version of FCFAST.

The PC version creates runstreams for transmission to FCCC over a telephone modem. Completed runs are 'captured' on the PC. If a data file was downloaded, the captured file may be processed for analysis by PC-based software such as PCFIRDAT (Blanchard 1989). The PC version requires no specific communication package-- only that the software be able to transmit an ASCII file to a host, and capture screen activity in a PC file.

FCFAST is menu-driven, and uses data entry screens to solicit required information, which is checked for validity. There is on-line, context sens[redacted]help for every menu and for the first entry field of each input scre[redacted]he on-line help is not intended to replace the User's Guides for the systems that FCFAST accesses-- you are expected to have a basic knowledge of the information required. However, between the on-line help, the input prompt associated with each input field, and error messages on invalid entries, you should be able to quickly construct error-free runstreams for transmission to FCCC.

The Main Menu of FCFAST provides 4 options:

1. FIRDAT (Firefamily) Activities,
2. NFDWL Activities,
3. NFODL Activities, and
4. Program Utilities.

Main menu options 1, 2, and 3 provide access to FCCC. Functions within each module are similar. You may:

1. Build runstreams, and

2. Prepare downloaded data files for local use.

Five topics common to these functions (runstreams, job set-up, sending jobs, retrieving output, and preparing downloaded data files) are discussed first.

RUNSTREAMS

A runstream is a text file containing everything required to initiate and complete a run at FCCC. Runstreams may be modified with a text editor. FCFAST uses default filenames for creating runstreams. They are:

FIRDAT.FCC for FIRDAT runstreams,
GET_NFWD.FCC for NFWDL runstreams, and
GET_NFOD.FCC for NFODL runstreams.

Runstreams reside in the working directory they are created in. Existing runstreams are always overwritten, so attention may be required when creating runstreams that aren't immediately sent to FCCC. If you create three FIRDAT runstreams using the default name, the file would contain the specifications of the last job created. Give each runstream a unique name in such events.

To send a runstream to FCCC, exit FCFAST and use your communication software to send the file as described below.

JOB SET-UP

A 'Job Set-Up' screen is displayed before a runstream is built and gets FCCC logon information (see Option 4 below) and the filename for the runstream.

I have had varying success with sending jobs over the modem to FCCC. There needs to be a pause between the @RUN card, the @PASSWD card, and the rest of the job. The most reliable method I've come up with breaks the job into two files. The first is called 'RUNCARD' and the second is whatever name you defined for the file. I have found that to physically enter the @PASSWD card works the best. You may find varying level of success with different sequences. The following describes what works for me over a commerical phone line.

Commerical telephone number is 303-221-4895.

Terminal Parameters are 7 bit words, 1 stop bit, Even Parity (7,1,E).

The FCCC prompt is the character '>'.

This requires 7 steps.

1. Start communications software.

2. Dial FCCC, select terminal type as CRT.

3. Select Application = C

4. Enter User ID and Password. Format is: *USERID/PASSWORD (the * lets you identify yourself, but not logon.)

5. Send the PC file called RUNCARD. (This file contains one record- the @RUN card.) The job is structured as a 'demand batch' run and is signified by the /B parameter on the @RUN card. When FCCC sees this, it treats all information up to the next @FIN card as a batch runstream.

   After you get the message:

   Batch Run Mode - Enter Runstream enter:

   @PASSWD pppppp (There will be no further prompts)

   After you've entered the @PASSWD card, send the runstream you want to run at FCCC.

   After the @FIN card has been processed, you will get the message:

   Terminal Inactive

   You may send more runstreams (RUNCARD, @PASSWD, and runstream), or continue at step 6.

6. Break the connection to FCCC with @@TERM

7. Hang up the phone.

```
                    ************************************************************************
        EXAMPLE SESSION TO SEND A RUNSTREAM TO FCCC
        ************************************************************************
Step 1. PROCOMM                              (Start Communication Software)
Step    Dialing FCCC                         (Software is dialing FCCC)

        CONNECT 1200                         (FCCC answers)
        <enter>
        FCCC: 1100/90 CCP8 (051690)     port: 809

        Terminal Type? >CRT                  (Enter terminal type)
        Enter system or application name:
Step 3. >C                                   (System C)
        ENTER USERID/PASSWORD CLEARANCE LEVEL
Step 4. >*1234ABCDEFGH/PPPPP                 (remember the *)
        *DESTROY USERID/PASSWORD CLEARANCE LEVEL*
        *SPERRY 1100 OPERATING SYSTEM  LEV. SC-39R8-2Q  (RSI)*
        ================================================================
                 NATIONAL COMPUTER CENTER AT FORT COLLINS
        ================================================================
        =>
        => System C  --  Message as of:  15 JUN 90 AT 07:54:47
        =>
        ================================================================
Step 5. >                                    (SEND RUNCARD FILE AT THE > PROMPT)
        *Batch Run Mode - Enter Runstream*
        @PASSWD PPPPP                        (ENTER ENTER @PASSWD PPPPP <enter>)
                                             (SEND RUNSTREAM. THERE IS NO PROMPT)
        *Terminal Inactive*                  (@FIN card was read)
Step 6. @@TERM                               (Break FCCC connection)
Step 7.                                      (Terminate Communication Software)
        ************************************************************************
```

This requires 10 steps.

1. Start communications software.

2. Dial FCCC, select terminal type as CRT.

3. Select Application = C

4. Enter User ID and Password. Format is: *USERID/PASSWORD (the * lets you identify yourself, but not logon.)

5. Use your communications software to capture screen activity to a disk file. If you include a directory as part of the file name, be sure it is the same one you have defined in your configuration file if you intend to use the INDEX function to list returned FCCC print files.

6. Set TTY mode to 132 characters wide. If you don't data lines longer than 80 characters long (FIRDAT Passing Files, NFODL - SPSS formatted files) will wrap around and FCFAST can not 'clean' them correctly.

   At > prompt enter @@TTY W,132

7. Enter @@SEND,U (This downloads queued output with your user id. Output is queued to a user by the '@SYM PRINT$,,userid/U' card in the runstream.) NOTE: If it has been an hour or so since you submitted the job and you get a *Terminal Inactive* message immediately after the @@SEND command, something has gone wrong and the job never ran because of an invalid userid/password/account number combination. If you are sure you entered the right password, try a longer pause between sending the RUNCARD file, entering the @PASSWD command, and sending the runstream. Ten seconds should be sufficient.

8. When the message:

   Terminal Inactive

   is displayed, stop capturing screen activity.

9. Break the connection with @@TERM.

10. Hang up the phone.

```
                    ************************************************************************
        EXAMPLE SESSION TO RETREIVE A PRINT FILE FROM FCCC
        ************************************************************************
Step 1. PROCOMM                                 (Start Communication Software)
Step    dialing FCCC...                         (Software is dialing FCCC)
        CONNECT 1200                            (FCCC answers)
        <enter>
        FCCC: 1100/90 CCP8 (051690)     port: 809
        Terminal Type? >CRT                     (Enter terminal type, CRT)
        Enter system or application name:
Step 3. >C                                      (System C)
        ENTER USERID/PASSWORD CLEARANCE LEVEL
Step 4. >*1234ABCDEFGH/PPPPP                    (remember the *)
        *DESTROY USERID/PASSWORD CLEARANCE LEVEL*
        *SPERRY 1100 OPERATING SYSTEM  LEV. SC-39R8-2Q  (RSI)*
        ============================================================
                NATIONAL COMPUTER CENTER AT FORT COLLINS
        ============================================================
        => System C  --  Message as of:  15 JUN 90 AT 07:54:47
        ============================================================
Steps 5. >@@TTY W,132           (Turn on file capture here and set terminal width
 and  6. @@ Complete.            to 132 characters.)
Step  7. >@@SEND,U              (Tells FCCC to send output queued to this userid)
        *OUTPUT FILE MODE*      (Image of print file follows....)

          RUNID * S22PA2        USER ID * 1234AAAAAAAA     PART NUMBER * 00
          INPUT DEVICE * TTY809         OUTPUT DEVICE * TTY809
          FILE NAME * PR@000S22PA2      CREATED AT:   12:27:37 JUN 16,1990
          PRINTED AT:   12:28:27 JUN 16,1990
        @RUN,L/B S22PA1,1234567890/1234AAAAAAAA,NFWDL,10
        @SYM PRINT$,,1234AAAAAAAA/U
        @ASG,A FIREDATALIB*PROGRAMS.
        W:122333 a write key exists on the file.
        @XQT FIREDATALIB*PROGRAMS.LISTFILES
                             STATION-YEAR LIMITS   DATE OF
         FILE                FROM      THROUGH   LAST UPDATE
         FIREDATALIB*00-03   00000000  03999999     031390
         ...
         FIREDATALIB*FSTALL  00000000  99999999     031490
        @FIN

          RUNID: S22PA1   ACCT: 1234567890   PROJECT: NFWDL    SYSTEM:  C
        ============================================================
                NATIONAL COMPUTER CENTER AT FORT COLLINS
        ============================================================
        => System C  --  Message as of:  15 JUN 90 AT 07:54:47
        ============================================================
        ***** COST SECTION *****
          CHARGES BASED ON   BATCH  RUN  AT L PRIORITY
          RT  ($000.26/MIN)   :$000000.00
          CPU ($001.71/MIN)   :$000000.00
          CCER($001.71/MIN)   :$000000.18
                               ----------
          ESTIMATED TOTAL COST:$000000.50   (MINIMUM CHARGE FOR BATCH)
                               ==========
St      **TERMINAL INACTIVE*              (Stop capturing screen activity)
Step    >@@TERM                           (Break connection with FCCC)
Step 10.                                  (Terminate Communication Software)
        ************************************************************************
```

PREPARING DOWNLOADED DATA FILES FOR LOCAL USE

Downloaded data files are included as part of the job's print file. The print file name is defined when you 'capture' the file.

To prepare a data file, specify the name of the returned print file and the resulting data file. Use the INDEX (Shift F2) key to select the desired print file. The new data file will reside in the current working directory. I call this process 'cleaning' a print file.

When cleaning print files is it critical to select the correct function (FIRDAT, NFWDL, NFODL) from which to select files for processing. Cross-cleaning may lead to unreliable results in the resultant data file.

Accessing FIRDAT - Option 1

You may generate FIREFAMILY runstreams for either the 1978 (Deeming and others, 1977) or 1988 (Burgan, 1988) version of the NFDRS. The data screens are identical for both versions-- the format of the runstreams differ.

There are four data screens -- one for each 'lead card.' They are presented in the logical sequence of lead card 1 through 4. Lead cards 3 (SEASON) and 4 (FIRINF) are optional. There is one lead card 1 and one lead card 2 per station. There may be up to three SEASON and three FIRINF cards per station. Each 'lead card' screen must be 'executed' to proceed to the next. If you are running SEASON or FIRINF, FCFAST automatically continues with the next logical input screen after the third SEASON or FIRINF lead card is executed. After FIRINF input is complete, FCFAST recycles to lead card 1 for a new station.

Weather stations may be entered in any order-- FCFAST sorts them by six digit station ID number when the runstream is built. As you enter stations, FCFAST tracks them sequentially. The sequential number (1,2,..) and station name are displayed at the top of each screen, along with the lead card number. On SEASON and FIRINF lead cards, the subcard (card 1 of 3, 2 of 3, or 3 of 3) is also displayed.

If you are not using an existing passing file (the usual case), weather data is automatically fetched from the NFWDL as a part of the FIRDAT runstream.

Passing file information is requested only on the first station (sequence number 1). If you create a new, or use an existing 'passing file,' you must provide its name and you may request that it be downloaded for local use. If you create one, you may save it at FCCC past six days.

To build a FIRDAT runstream, ESC from the adminstrative owner name field (field 1, lead card 1). The runstream will include the previously 'executed' station(s). If you ESC from the owner field on the first station, no runstream is built and control returns to the FIRDAT menu. You may move backwards between lead cards (e.g. from card 2 to card 1) by using ESC key. Forward movement should always be accomplished with 'execute' (F1).

Refer to the appropriate FIRFAMILY User's guide for specific information on the contents of the specific lead cards and passing files. There is on-line help about fuel models when the cursor is on a fuel model field on lead cards one or two.

Accessing NFWDL - Option 2

There are three option in accessing the NFDWL at FCCC. You may:

1. Make a GETDATA2 runstream to generate datasets,

2. Make a LISTFILE runstream to list the stations on the NFWDL tapes, or

3. Make an INVENTORY runstream to list the contents of specified NFWDL tapes (you enter the tape names as defined in a LISTFILES run).

Option 1. GETDATA2

Select create a new runstream and the NFWDL data screen is shown. Enter the station number and year specifications for up to 10 stations. Stations may be entered in any order. Leave the station ID blank to move to the file definition section of the screen.

Station Number: Six-digit station id number. Leave blank if done entering new stations.

Begin: Year (yy) to begin data extraction. (00 to 99)

End: Year (yy) to end data extraction. (Begin to 99)

Catalog File?: Y - Create a cataloged file at FCCC. You must also specify the filename, and whether to save the file past six days. (At FCCC, files are deleted after 6 days unless @SAVE'd. It is usually cheaper to recreate weather files than store them.)
N - Do not create a cataloged file. Enter N only when downloading a file for local use and you don't want to use the data at FCCC.

Filename: FCCC filename for file you are creating. FCCC files have two parts-- the qualifier and the filename. Both are up to 12 alphanumeric characters (no special characters).

Save past 6 Days: Y - Invoke @SAVE processor. You must also must provide a 'save date' and a description of the file.
N - File is automatically purged in 6 days

Download to Host: Y - Download a copy of the weather data to the host.
N - Do not download data file to host.

Execute: Y - Use current screen to build a runstream.
N - Edit current screen starting at the first station.

Option 2. LISTFILES - No input required--goes right to job set-up screen.

Option 3. INVENTORY - Enter the tape name (from LISTFILES) for each tape you want an inventory of. Blank to continue, execute to generate the runstream.

Accessing NFODL - Option 3

Select build a new runstream and the NFODL input screen is displayed. NFOD[redacted]treams are built region by region. You are responsible for knowing the [redacted]c ADP codes for the regions/forests/districts you extract data for.

Agency: Agency code for fires to extract. If you ESC the first time here, you return to the main menu. ESC here any other time builds the runstream using previously executed 'region' screens.

Region: ADP code for a region.

Begin: Year (yyyy) to begin. (1970 to current year - 1)

End: Year (yyyy) to end. (Begin to current year - 1)

Forests: Forest ADP code(s) for the region. Enter a list (e.g. 1,5,8), a range (e.g. 1-5), a combined list and range (e.g. 1-5,8,11-14, 17), or ALL. If you enter anything other than ALL, you must define the districts for each forest. Data are extracted for the same years for each forest. (This differs from directly accessing NFODL without FCFAST where you may override the region specified years on the forest card.)

Districts: ADP code(s) for the desired district(s) for each specified forest. FCFAST builds the district portion of the screen based on the forest specifications (the region and forest ADP codes are displayed as part of the input field). District entry is the same as forest (list, range, combined list and range, or ALL)

Format: Format(s) for the data file(s). Valid entries are SPSS, FUEL, FPL, or QQ. (See Yancik and Roussopoulos, 1982.) You must enter at least one, you may enter more. Separate entries by a space (e.g. SPSS FPL). If you enter multiple formats and download the file, only the first format is downloaded.

Download: Y - Download a copy of the data file to the host. Remember, only the first format on multiple format runs is downloaded, although all formats are created at FCCC.
N - Do not download a copy of the data file to the host.

Execute: Y - Screen values are included in the runstream. Screen recycles for another region.
N - Edit districts on current screen.

Program Utilites - Option 4

The Program Utilities module allows you to create/modify the FCFAST configuration file. This file, FCFAST.CFG, resides in your working directory and contains default values used in the FCCC @RUN and @PASSWD commands. The default values may always be overridden.

The parameters contained in the configuration file are:

1. Run Priority. You may use L, N, P, or W. L is the highest priority and has a turn around time of about 10 minutes. N is one hour, P overnight, and W is weekend. L is the most expensive, W the least. P priority jobs usually come back within the hour.

2. Run Id: 1 to 6 alphanumeric characters, no special characters.

3. Account Number: 10 numeric characters.

4. Run Qualifer: 1 to 12 alphanumeric characters, no special characters. This defines the default 'qualifier' portion of any files created at FCCC during a run. FCFAST sets the run qualifer to the system being accessed (FIRDAT, NFWDL, or NFODL).

5. User ID: FCCC User ID.

6. Password: FCCC Password associated with User ID.

7. PC Directory: Directory where returned print files are stored.

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Appendix B

NARTC Class Outlines

1989:Correlation of Fire Activity

1989:Correlating Fire Activity with NFDRS Outputs

1990:NFDRS/Fire History Analysis

Lesson Evaluation Comments (1989)

Lesson Handouts (1989, Correlating Fire Activity)

NATIONAL ADVANCED RESOURCE TECHNOLOGY CENTER

INSTRUCTOR:	Pat Andrews
LESSON:	Correlation of Fire Activity
UNIT:	VI-B
COURSE:	National Fire Danger Rating System

OBJECTIVES:

Upon the successful completion of this unit, the student will be able to:

1. Explain why NFDRS indexes should be compared to fire history records.
2. Define a measure of "fire business" against which NFDRS can be compared.
3. List 4 potential applications of the results of an analysis of the correlation between NFDRS and fire history.
4. Describe the status of current work on correlating NFDRS and fire history, and provide input (personal opinion) on what the future should be.

NARRATIVE:

I. INTRODUCTION

A. Lesson objectives

B. Lesson organization

1. Inspiration -- why we are working on this.
2. List potential applications (will come back to this list throughout the lesson).
3. What is a measure of "fire business?"
4. Example data summaries
5. Logistic model for probability of a fire-day.

6. Example applications.

7. History, status, and future of this work. Class discussion.

II. WHY WE ARE WORKING ON THIS

A. Fire danger rating systems have been used in the U.S. since 1934. A national system was introduced in 1964. Yet it seems that we still haven't resolved the problem of what NFDRS is supposed to do.

B. Quotes from meeting reports for NFDRS Improvement Workshop (USDA Forest Service 1985) and NFDRS-East Workshop (USDA Forest Service 1986):

1. "No consensus exists on the purpose or application of Fire Danger Rating"

2. "Many fire managers are using the 1978 NFDRS as a fire behavior indicator even though it is not intended for that purpose."

3. "There is no agreement about the measures of 'fire business' the NFDRS is expected to track/emulate."

4. "No method or procedure exists for validation and/or testing NFDRS performance."

C. From the Final Report on Fire Management Policy (USDA/USDI 1989):

1. "Validation of the relationship between current fire management information system components (i.e. drought index, energy release component, 1000 hour fuel moisture, etc.) with actual fire occurrence, severity and size is needed."

III. POTENTIAL APPLICATIONS

A. Method of choosing a fuel model and index.
There is a choice of 20 fuel models and several indexes. How is a person supposed to pick from those 100+ choices? Fuel model is generally chosen from the description of the vegetation and from personal experience in what seems to best reflect the fire season. We hope to offer a more objective way of making the choice.

B. Testing NFDRS.
How are we supposed to improve the NFDRS if we don't have a measure of how well it's doing? How will we know if we've really improved it? We use our methods to compare '78 and '88 NFDRS.

C. Setting index levels.
The current suggested method of setting index classes is based on the 90th and 97th percentile values. If additional information on the relationship of index to fire history is used, better critical values can be chosen.

D. Making NFDRS more credible.
Meaning is added to NFDRS indexes in terms of observable "fire business."

E. These relationships might even be used as the core for NFMAS-type planning programs.

IV. WHAT IS A QUANTITATIVE MEASURE OF FIRE DANGER

A. What is NFDRS supposed to rate? Fire danger is something that most fire managers have a feel for. A person just KNOWS when fire danger is high or low. In fact some people/offices rely on those feelings alone. Others see the need for a more objective means of making decisions, based in part on NFDRS.

B. It is 'easy' to test a fire behavior prediction. A plot can be made of predicted vs. observed flame length or rate of spread, something that can be observed and measured. The values required to make the fire behavior calculations are also measured and observed on site.

C. But what goes on the 'observed' axis of a similar graph that illustrates the performance of NFDRS? When you want to compare ERC against something, you certainly don't go out and measure available energy in Btu's per square foot and divide by 25! Some people avoid using ERC because they don't know what a Btu per square foot looks like. Understandable.

D. You might suggest that BI be compared to observed flame length divided by 10. But remember the philosophy of fire danger rating and what goes into the calculation of BI. You wouldn't expect flame length to be the same for all of 24 hours of the day for every location in the rating area. There should be a relationship between flame length and NFDRS indexes, but not a straight line predicted vs. observed relationship like you hope to get with a test of fire behavior prediction.

E. Another problem with using observed fire behavior as a measure of fire danger is that those numbers are hard to come by. We wanted to come up with something that can be widely used.

F. We wanted to use information from the National Fire Occurrence Data Library (NFODL). Much of the information in that data base in unreliable. We used mainly discovery date and fire size.

G. Look what happens if you plot final fire size against index. Lots of scatter. That's what you would expect anyway. Just think of all of the variables that are involved in determining the final size. However, you would hope that most of the big fires start on a high index day. We will use enough data in order to look at things on a probability basis. We aren't trying to predict the behavior of individual fires.

H. Fire-day turned out to be a very good measure of fire danger. It is much more than an indicator of occurrence. In order for a fire to be in the NFODL, it must have been reported.

   1. If people are burning ditch banks and the fire escapes and they put it out themselves, it is not reported. If it gets away, it is reported.

   2. Trains are always generating sparks. If 'fire danger' is low, no fires are reported. If fire danger is high, we have record of fire starts.

   3. A lightning storm may cause lots of fires that just smolder until the fire danger rises. Then they 'take off' and are reported. That's one of the reasons we used date of discovery rather than occurrence.

I. We also look at relationship between index and large fire occurrence and multiple-fire days.

V. PROBABILITY OF A FIRE-DAY

A. A day is a fire-day if one or more fires were reported. Otherwise it is a no-fire-day. In numerical terms, that's 1 for fire-day and 0 for no-fire-day. Our method gives probability of a fire-day for a given NFDRS index.

B. You cannot expect NFDRS to tell you exactly what every fire will do or what will happen on each day. But it should be able to tell you something on a probability basis.

C. George R. Fahnestock (1975) put the interpretation of fire danger rating in perspective with a half-page article: "Playing the Odds, or What the Canadian Fire Weather Index Means in Alberta." He showed the relationship of fire occurrence and area burned to the Fire Weather Index (FWI) on a ratio basis. He concluded: "Anybody who thinks it's fun to buck the 2:3 odds at Las Vegas with his own money should be deliriously happy to stake government funds on the FWI with the odds strongly in his favor."

VI. EXAMPLE--LOLO NF

A. ERC, fuel model G.

1. Table of observed values. 12 ERC ranges (no special significance for those particular ranges). For each ERC category: no. days, no. fire-days, fraction of fire-days.

2. The fraction is the important number, not the number of days.

3. Same as previous table but with the addition of predicted number of fire-days and the fraction of fire-days.

4. Plot of logistic curve plus observed data points.

B. Plots of other indexes and fuel models for Lolo: SC, 1000-h, etc.

VII. INTERPRETATION OF THE PLOTS

A. You can look at these plots and see that there is not a strong relationship between some indexes and percent fire day. But your eye doesn't tell the whole story. Some of the observed points are based on 1000 days, others on 20.

B. And you can't just look at the plots to pick one of the 100 fuel model/index choices. Some important statistics analysis is behind these plots. (I'm sure you don't want to hear about it. Wait until they make our technical papers into movies.)

C. Keep in mind that probability of a fire-day should be looked at as an indication of overall fire danger. I don't want you to think that these curves are just for predicting whether a fire will occur on this day or not.

VIII. MULTIPLE-FIRE-DAYS AND LARGE-FIRE-DAYS

A. Example--Lolo.

B. Plot of probability of fire-day and of 3+,5+, AND 10+ fires per day.

IX. PERCENTILES FOR INDEX FOR ALL DAYS, FIRE-DAYS, AND LARGE-FIRE-DAYS.

A. Distribution of index values and corresponding percentile curve. This is the information that is currently used to set critical levels. Show similar information when only fire-days are included.

B. Percentile curves for all-days, fire-days, and large-fire-days.

1. Lolo--no difference between fire-days and large-fire-days. Interpret difference between all-days and fire-days.

2. Stanislas NF--Interpret difference between all-days, fire-days, and large-fire-days.

a. 30% of all-days had BI>100
70% of large-fire-days had BI>100

b. 50% of all-days had BI>50
50% of fire-days had BI>80
50% of large-fire-days had BI>125

X. HISTORY, STATUS, AND FUTURE OF THIS WORK

A. History.

1. I almost hate to admit how long ago I 'started' on this. The fire behavior project was asked to look at possible improvements to the 1972 NFDRS. I was concerned with the question of how we could tell if the changes were really improvements. I looked at a comparison between fire history and the '72 NFDRS and a revised NFDRS even before Deeming, Burgan, and Cohen came to Missoula to develop the 1978 NFDRS.

2. I've recognized the need and the potential for this analysis for a long time. I got it off of the shelf and did a little here and there. Other things always took priority.

3. I wrote a paper describing some of the initial analysis and ideas: "The National Fire Danger Rating System as an Indicator of Fire Business" (1987).

4. I'm certainly not the only one to think about doing this. In fact when I went through historical fire danger rating documents, I wondered why I was doing it. It had been done so many times before. But those studies were done for a specific area and time. I wanted to develop a method that could be used by others. Computers and the national data bases make this feasible.

B. Status.

1. I finally admitted that I would never find time to do this myself. I began working with Dr. Don Loftsgaarden, a statistician in the math department at the University of Montana. He quickly picked up on the problem and followed Dr. Dave Martel's (Faculty of Forestry, University of Toronto) lead in using logistic regression in the analysis.

2. Larry Bradshaw (research meteorologist, Systems for Environmental Management) developed the computer access to the data bases at FCCC and greatly streamlined the analysis using the SAS statistical software. Larry and I are working on specific applications of the methods developed by Don. Our main focus is guidelines on setting decision points.

3. This is still a research project. We are testing our methods on specific problems. We have not designed a system for use by others. It will not be a trivial job to do that. It requires access to data bases that currently reside on a remote mainframe computer and analysis with a statistical program.

C. Future.

1. The future of this work depends to some extent on the reaction we get from what we're presenting here.

2. What's your opinion? Is it "Why did you wait so long? It's about time." or "Why don't you spend your time doing something useful?" or something in between?

3. Do you see potential application?
What should we do next?

NATIONAL ADVANCED RESOURCE TECHNOLOGY CENTER

INSTRUCTOR:	Pat Andrews and Larry Bradshaw
LESSON:	Correlating Fire Activity with NFDRS Outputs
UNIT:	VIII-D
COURSE:	National Fire Danger Rating System

OBJECTIVES:

Upon the successful completion of this unit, the student will be able to:

1. Explain the process of correlating fire activity with NFDRS outputs (computer access, etc.).
2. Use relationships between NFDRS indexes and fire activity to set decision levels (low, medium, ...).
3. List three considerations in setting decision levels.
4. Provide input (opinion) on how this research might be implemented as a management tool.

NARRATIVE:

I. INTRODUCTION

A. Lesson objectives

B. Lesson organization

1. Overview of the way that we access NFWDL and NFODL; calculate NFDRS indexes; merge the weather, NFDRS output, and fire records; develop models for probability of a fire-day; and plot relationships.
2. Review some of the information that was presented in unit VI-B from the previous week of the course.
3. Go through a specific example of setting decision levels-- Lolo NF, ERC, fuel model G.
4. Through interaction with the class, set levels for Black Creek NF in Mississippi and Stanislas NF in California.
5. Class discussion on where this work should go-- if and how it should be implemented as a management tool.

II. PUTTING THINGS IN PERSPECTIVE

A. As I explained in a previous lesson (VI-B), this work is in the research stage. It is not yet in the systems development stage. Your reaction to what we present here may help determine the direction we will take from this point.

B. You've learned how to do an analysis of historical fire danger data using currently available programs: FIRDAT, SEASON, and FIREINF. We will show you how we've set up programs for our use. You will have to accept the fact that they're not available to you now.

C. We want you to think about how current programs are set up and how ours operate in order to make recommendations. We don't want to confuse things by adding another program. I think that we can combine and streamline things.

D. This lesson is part of the unit called "Introduction to problem analysis on computers." But since we don't have programs for you to work with, you will have to put up with paper and pencil.

III. SYSTEM DESIGN AND ANALYSIS PROCESS

A. Streamlined access to NFODL and NFWDL at FCCC. Bring data back to IFSL DG.

B. Calculation of NFDRS output using a modified FIRDAT at IFSL. Can do calculations for more than one fuel model at a time. (We had the need to run all 20 fuel models through.)

C. Use SAS to merge fire records, weather, and NFDRS output into one file.

1. Assign a station number to each Forest/district.

2. Deal with occasional weather outside of a specified season and fires without weather.

D. Use SAS to produce basic data summaries: fire size classes, fires/day, cause, etc.

E. Use SAS to plot percentiles for all days, fire-days, etc.

F. Use SAS to develop logistic regression models for probability of a fire-day, etc.

G. Note that this was set up for our use. We relied heavily on SAS. And we did everything on the DG (after retrieving data from FCCC). If it is determined that it should be developed for fire managers, the design will be different. It is not necessary to have an infinite number of opitions. Most users will not have access to SAS. Specific needed procedures might have to be programmed for this application. And many people use PC's rather than the DG.

IV. BASIC SUMMARY INFORMATION

A. Distribution of fire sizes. Use this to define "large-fire." The distribution of fire sizes for the Lolo in Montana is very different from Black Creek in Mississippi.

B. Distribution of number of fires per day. Use this to define "multiple-fire-day." This will depend on the area under consideration. For example, a polygon in a regional map is much smaller than a polygon on the national NFDRS map.

C. Fire cause. Lightning vs. human. Compare Mississippi and Montana.

D. Distribution of index. Percentile.

V. DATA SUMMARIES FROM THE MERGED FIRE/INDEX FILE

A. Percentile for fire-day, large-fire-day, and multiple-fire-day.

B. Percentile for fires and large-fires.

VI. MODELS DEVELOPED FROM THE MERGED FIRE/INDEX FILE

A. Probability of a fire-day, large-fire-day, and multiple-fire-day.

B. Compare predicted and observed. Remember that each observed point is made up of a number of observations. Your eye doesn't always do a good job of assessing the fit of the model to the data. We won't talk about test of fit here, but it's important.

C. A model may be better than the actual values. The observations must be grouped in order to display a point (percent fire-day). A different grouping will show different points. The model doesn't depend on the grouping.

VII. CONSIDERATIONS IN SETTING LEVELS

A. What decisions or actions will be based on the results.

B. First level--broad area fire danger rating. Next level--more site-specific fire behavior, depends on actual location in relation to fuel type, civilization, etc. Depends on values at risk.

C. What is a good indicator of "fire danger" in your area--large-fires or multiple-fire-days.

D. Over the long run, how many days would you like to have in each category-- e.g., 90th and 97th percentile of all days.

E. What else--class discussion. Look at plots showed earlier.

VIII.EXAMPLE OF SETTING LEVELS--LOLO

A. Line up pertinent graphs. Look at relationships. Use professional judgement to draw lines.

B. Class discussion.

IX. SETTING LEVELS--BLACK CREEK AND STANISLAS

A. Small group discussion.

B. Class discussion.

X. WHAT NEXT -- class discussion.

INSTRUCTOR:	Larry S. Bradshaw
LESSON:	NFDRS/Fire History Analysis
UNIT:	V-B
COURSE:	National Fire Danger Rating System (Applications)

OBJECTIVES:

Upon the successful completion of this unit, the student will be able to:

1. Explain why NFDRS indexes should be compared to fire history records.
2. Define a measure of "fire business" against which NFDRS can be compared.
3. List the steps required to correlate fire activity with NFDRS outputs.
4. List 4 potential applications of the results of an analysis of the correlation between NFDRS and fire history.

NARRATIVE:

I. INTRODUCTION

A. Lesson objectives

B. Lesson organization

1. Inspiration -- why we are working on this.
2. List potential applications
3. What is a measure of "fire business"?
4. Logistic model for probability of a fire-day
5. Steps in Analysis
6. Example applications

II. WHY WE ARE WORKING ON THIS

A. Fire danger rating systems have been used in the U.S. since 1934. A national system was introduced in 1964. Yet it seems that we still haven't resolved the problem of what NFDRS is supposed to do.

B. Quotes from meeting reports for NFDRS Improvement Workshop (USDA Forest Service 1985) and NFDRS-East Workshop (USDA Forest Service 1986):

1. "No consensus exists on the purpose or application of Fire Danger Rating"

2. "Many fire managers are using the 1978 NFDRS as a fire behavior indicator even though it is not intended for that purpose."

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4. "No method or procedure exists for validation and/or testing NFDRS performance."

C. From the Final Report on Fire Management Policy (USDA/USDI 1989):

1. "Validation of the relationship between current fire management information system components (i.e. drought index, energy release component, 1000 hour fuel moisture, etc.) with actual fire occurrence, severity and size is needed."

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There is a choice of 20 fuel models and several indexes. How is a person supposed to pick from those 100+ choices. Fuel model is generally chosen from the description of the vegetation and from personal experience in what seems to best reflect the fire season. We hope to offer a more objective way of making the choice.

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How are we supposed to improve the NFDRS if we don't have a measure of how well it's doing. How will we know if we've really improved it? We use our methods to compare 78 and 88 NFDRS.

C. Setting index levels.
The current suggested method of setting index classes is based on the 90th and 97th percentile values. If additional information on the relationship of index to fire history is used, better critical values can be chosen.

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Meaning is added to NFDRS indexes in terms of observable "fire business."

E. These relationships might even be used as the core for NFMAS-type planning programs.

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A. What is NFDRS supposed to rate? Fire danger is something that most fire managers have a feel for. A person just KNOWS when fire danger is high or low. In fact some people/offices rely on those feelings alone. Others see the need for a more objective means of making decisions, based in part on NFDRS.

B. It is `easy' to test a fire behavior prediction. A plot can be made of predicted vs. observed flame length or rate of spread, something that can be observed and

measured. The values required to make the fire behavior calculations are also measured and observed on site.

C. But what goes on the `observed' axis of a similar graph that illustrates the performance of NFDRS? When you want to compare ERC against something, you certainly don't go out and measure available energy in Btu's per square foot and divide by 25! Some people avoid using ERC because they don't know what a Btu per square foot looks like. Understandable.

D. You might suggest that BI be compared to observed flame length divided by 10. But remember the philosophy of fire danger rating and what goes into the calculation of BI. You wouldn't expect flame length to be the same for all of 24 hours of the day for every location in the rating area. There should be a relationship between flame length and NFDRS indexes, but not a straight line predicted vs. observed relationship like you hope to get with a test of fire behavior prediction.

E. Another problem with using observed fire behavior as a measure of fire danger is that those numbers are hard to come by. We wanted to come up with something that can be widely used.

F. We wanted to use information from the National Fire Occurrence Data Library (NFODL). Much of the information in that data base is unreliable. We used mainly discovery date and fire size.

G. Look what happens if you plot final fire size against index. Lots of scatter. That's what you would expect anyway. Just think of all of the variables that are involved in determining the final size. However you would hope that most of the big fires start on a high index day. We will use enough data in order to look at things on a probability basis. We aren't trying to predict the behavior of individual fires.

H. Fire-day turned out to be a very good measure of fire business. It is much more than an indicator of occurrence. In order for a fire to be in the NFODL, it must have been reported.

   1. If people are burning ditch banks and the fire escapes and they put it out themselves, it is not reported. If it gets away, it is reported.

   2. Trains are always generating sparks. If 'fire danger' is low, no fires are reported. If fire danger is high, we have record of fire starts.

   3. A lightning storm may cause lots of fires that just smolder until the fire danger rises. Then they `take off' and are reported. That's one of the reasons we used date of discovery rather than occurrence.

I. We also look at relationship between index and large fire occurrence and multiple-fire days.

V. PROBABILITY OF A FIRE-DAY

A. A day is a fire-day if one or more fires were reported. Otherwise it is a no-fire-day. In numerical terms, that's 1 for fire-day and 0 for no-fire-day. Our method gives probability of a fire-day for a given NFDRS index.

B. You cannot expect NFDRS to tell you exactly what every fire will do or what will happen on each day. But it should be able to tell you something on a probability basis.

C. George R. Fahnestock (1975) put the interpretation of fire danger rating in perspective with a half-page article: "Playing the Odds, or What the Canadian Fire Weather Index Means in Alberta." He showed the relationship of fire occurrence and area burned to the Fire Weather Index (FWI) on a ratio basis. He concluded: "Anybody who thinks it's fun to buck the 2:3 odds at Las Vegas with his own money should be deliriously happy to stake government funds on the FWI with the odds strongly in his favor."

VI. STEPS IN ANALYSIS

A. Step 1: Data Preparation - Databases

1. Fire Occurrence Data - Need discovery date, size, cause.
   a. National Fire Occurrence Data Library (NFODL)
   b. ?????

2. Fire Weather or Fire Indexes for predictor variables.
   a. National Fire Weather Data Library (NFWDL)
   b. FIRDAT - Uses NFWDL data to generate NFDRS indexes

3. Merge occurrence data (1) with predictor variables (2) by date:
   a. date
   b. predictor variable(s)
   c. fire-day (yes/no)
   d. large fire-day (yes/no)
   e. multiple fire-day (yes/no)

B. Step 2: Data Analysis

1. Fire occurrence summaries from (1) above:
   a. cause distribution
   b. size distribution
   c. seasonal distribution

2. Predictor variable summaries from (2) above:
   a. fire weather climatology: All Days Only
      (1) Means, ranges, frequency distributions...

3. Predictor variable summaries from (3) above:
   a. fire weather climatology: fire-days, large fire-days, multiple fire days
      (1) Means, ranges, frequency distributions...

C. Step 3: Logistic Model Development

1. Probability of fire-day for a given value of a predictor variable.
   a. P(fd|index) = 1./(1.-exp(a + b*index))

D. Step 4: Model Evaluation

1. Goodness of Fit
   a. Chi Square
   b. R-Squared

2. Range of Probabilities Over the Range of the Predictor Variable
   a. .1 to .9 is very good
   b. .2 to .3 is useless

3. Distribution of Predictor Variables
   a. wider range allows more flexibility in setting levels
   b. don't want 90 percent of observations in one/two classes

VII. EXAMPLES: MONTANA, MISSISSIPPI, CALIFORNIA

A. Fire Occurrence

1. Cause
2. Size
3. Yearly/Seasonal
4. Size by Cause

B. Fire Weather/Danger: Cumulative distributions - All Days

1. Distribution of index values and corresponding percentile curve. This is the information that is currently used to set critical levels.

C. Fire Business: Cumulative Distributions - Fire-Days/Large Fire-Days/Multiple Fire-Days

1. Lolo-- no difference between fire-days and large-fire-days.

   Interpret difference between all-days, fire-days, and multiple fire-days..

2. Stanislaus NF-- Interpret difference between all-days, fire-days, and large-fire-days.
   a. 30% of all-days had BI>100
      70% of large-fire-days had BI>100
   b. 50% of all-days had BI>50
      50% of fire-days had BI>80
      50% of large-fire-days had BI>125

D. Logistic Models

1. ERC - Model G
2. SC - Model C
3. BI - Model G
4. 1000 Hour TLFM

E. Interpretation of the plots.

1. You can look at these plots and see that there is not a strong relationship between some indexes and percent fire day. But your eye doesn't tell the whole story. Some of the observed points are based on 1000 days, others on 20.

2. You can't just look at the plots to pick one of the 100 fuel model/index choices. Some important statistics analysis is behind these plots. (I'm sure you don't want to hear about it. Wait until they make our technical papers into movies.)

3. Keep in mind that probability of a fire-day should be looked as an indication of overall fire danger. Don't think that these curves are just for predicting whether a fire will occur on this day or not.

Correlation of Fire Activity

Lesson Evaluation Comments

Hard data to verify budget requests is priceless.

Whatever system or process is developed should be usable at the field office level. For Forest Service, this would be Oracle and/or PC-based, preferably PC. This I believe would promote a greater understanding of the use and application and decisionmaking.

Would like to work with these for a while, tape a few graphs up, watch over time, and correlate, then make some comments.

Very interesting; I would like to utilize this approach at my district to test and verify this approach of using the NFDRS information. It is refreshing to see new approaches of using NFDRS data.

At times I felt some of the information going over my head. Otherwise, it was a good lesson. Use of audio/visual aids was adequate. Quality of material presented was very applicable to the audience. The content of the lesson should have more emphasis placed on the manager's portion. The value of the material was excellent. I know enough now to be dangerous when I visit some of the Forests. Feel the lesson could be improved with a few more examples of what some units are using. Good staff!

Additional comments: Don't put too much emphasis on size classes, particularly on B & C class fires. For some reason Mississippi has the largest acreage per fire of any other southern state. Impacts of the manager's decision on what appropriate suppression action to take? I think concentration should be made on class day & multiple fires.

Jerry's comments were very appropriate. I think the class could have used more examples of how people are using indexes for the staffing for fire danger.

No question it is of value, but to what degree and can it be made more simple? I wonder how complicated this has to get to be understood and practically used by district managers--will it be readily used.

This has more practical application to the field units than any other aspect covered this week. Keep at it.

Complex subject was well presented. Good use of humor. I see potential for use of correlation locally for planning and actually staffing. This needs to get to the "ground" in a form that is usable and easily understood. I strongly endorse continuation of work on the project. Bring a usable system to the

field. Application/development (setting of decision points) would be of great value.

How can the forests do this when we can't even hire crews because of the budget? It is good information but we have more to do than work on NFDRS. We have NFMAS, forest plans, training of crews (if we can hire them), action plans, and "real" fires to work, and maintaining Wx (RAWS).

I'm getting frustrated with all the computer things and then no crews to actually put out the fires. What are we doing? Fire managers need this information, but "People put the fires out."

Good relations. Mississippi and Montana are the same!! We as managers don't have time to do all of this or the programs.

Graphics were superb and greatly supported the lesson plan! This was good, Pat. This is material I could relate to, understand, and use! I'd like some structure, with accordance for some options to be used; site-specific as applicable.

Super! Vintage Pat Andrews again! Good to see. Use of audio/visual aids well suited to the audience. Timely and useful. Thanks, Pat.

Very interesting.

Quality of instruction very good, to the point, and explained both pluses and minuses of work being explained. Audio/visual aids very necessary to gain good understanding--they show what was being taught. Quality of material--while not hard facts, presentation of concepts, trends, and possibilities were very good. The material was of help in determining direction of use of historical data for prediction.

Can't think of how this lesson could be improved; I think the light came on!

Took a potentially tough-to-understand subject and leveled with students. Graphics very vivid and a good representation of material presented. Other than view graphs and presentation not following lesson plans very closely... excellent. Very exciting study. . . Keep the snowball rolling. Great job!

Clarity of subject was quite confusing at times. Graphs were good, but subject was a bit over my head. I honestly don't think this subject was needed. I think it was over a lot of the audience's head.

Well prepared; excellent. Pat did an excellent job of explaining really tough/complicated information. Excellent lesson plan--I plan to re-read it often! Really important stuff! For managers, this is some of the best stuff all week!

Great presentation; clear and very well organized. Excellent graphics. Excellent value for the users of the NFDRS system.

Ya do a good job, Pat. Materials look good to me, but I don't know? Good to know something is going on. Plunge ahead, Pat.

Maybe the application reference like the man from Lolo NF could be incorporated and updated in the future for NFDRS application to real-world situations. These will come in time and should be shared. This line of analysis shows promise to simplify fire rating and should be pursued. The current system is cumbersome, not only to professionals, but politicians, upper management it's impossible to generate interest. This offers utilizing the same components and indices into much simpler graphic understanding of relationships to laymen concerns and non-fire professional managers. Some multivariate analysis and 3-dimensional graphics might be of value.

It may be worth trying the data for a Forest region or multi Forest/BLM district area of relatively similar climate and fuel types. I suspect some of the Idaho fire history may give a greater data base of ends of curve data. Will it work for areas larger than one Forest? Do the Lolo Forest data truly represent western Montana? I think a merging of several forests' data is necessary to validate--also different rates of fire management, i.e., wilderness vs other multiple use areas could distort data.

The correlation of activity with the indices is something that is way past due. I feel that there should be a specialist located in the Regional Offices to work with the Forests. Most of the Forests probably do not have the expertise to understand and analyze the data with infinite choices.

I liked the presentation--it works! I like all the variables but would have trouble remembering them all. I also don't think I have time to do another program! Make a quick _____ easy way to get the runs!

As far as trends in predicting--At present it seems numbers for percentile are available in NFDRS. This can be used very well by us. Selection of index to use may take trial and error, but for planning this should be very useful. Mixing indexes to come up with a better fit. This may turn out to be an art based on experience to decide what indexes in what proportion to use. There may be a misconception in using historical data to predict future danger. This may be clarified by stressing use in prediction of possibilities. Also, if MCR or LR changes, may change value of indexes in prediction. Real good presentation.

I will call you one of these days and discuss the possibility of doing some of these things for BLM. We still use B1 which may not be all bad, but I would be interested in doing some correlations with other values for us. In designing your system, I believe it has a lot of value but the simpler you can make it and the more universal it is, the more use will be made of it.

Pat, I feel strongly that the work in correlation needs to continue to get out the the "field." As a manager, I would feel much more comfortable with decisions that have a good "statistical" background. As the system is developed, it needs to include aids to help in making "Decision levels/break points." The thresholds for considerable fire activity are critical. I believe most managers may have an idea of what they are, but cannot substantiate them with anything concrete (or even asphalt). Analysis should involve drought index in the future. I believe a correlation would be valuable there as well as ERC, BI, 10-hour, etc. Analysis by use of curves, graphs would benefit us immensely. It's difficult to comment regarding structured or infinite possibility system. Maybe a combination of both! Keep up the good work and good luck on this project!

While I mentioned the applicability would be good, there will be very little use, I think, in our part of the world in preparing the equations to develop the frequency charts, etc. I don't think our users know how. If something "simple" is available, OK. I think that enough analysis would have to be done to cover geographical areas, i.e., representatives from central plains, Piedmonts, mountains. Also capabilities, limitations, must be considered. But maybe that needs to be done on the ground or at the ground level. Go ahead with your work in the direction you are aimed. Think direction is correct. Also, I wonder if we really consider that line fuel moisture is our 1,000-hr? See you in February.

This system looks great! It needs to be completed as soon as possible. I would think that a program that generates a set of data files for one analysis, i.e., one fuel model/slope, etc., combination would be good. If this data file could be loaded into a spread sheet or graphics package for display--that would probably be the easiest. I have fire data bases and weather data bases and a small programming organization to develop the system for PC technology.

Excellent graphical look at fire history. I'd like to see it produced and published by area for the BI, ERC, % graphs, explanations, etc. that you showed. As for us being able to do some of these, I feel it would be a nice option but not sure if we would all have the statistical knowledge to produce the quality work you've produced here. Excellent work.

The concepts make sense. I see this as very useful tool to make decisions on when you should start staffing and what level. I would like a system that would be relatively simple to use and take a relatively short time to use. This would raise the probability of the analysis being done.

Regarding weather and occurrence data bases: We (NPS) would produce a better batch of data sets, with greater chance of containing information, if you just provided guidance in the format you need them in. Let us pay over and clean up/select the entry bits and get them ready for analysis; then enlist your help in doing the analysis (at our expense, of course).

I believe you're on the right track. A structured method of looking at our fire history, and thereby making a choice as to how to manage the "fire business" is needed. It should have an infinite (or large) number of choices. My principle contribution to your work is in the nature of a title. Deeming has his "fire weenie." I suggest the moniker of "fire slug" for what you showed us.

Considered coefficient of ignition relate probability of ignition to actually ignite place of ignition. Need to standardize effort available to suppress fire--or present potential/fire size index. How many "0" level reportable fires are campsite creep, trash can--not wildland fires.

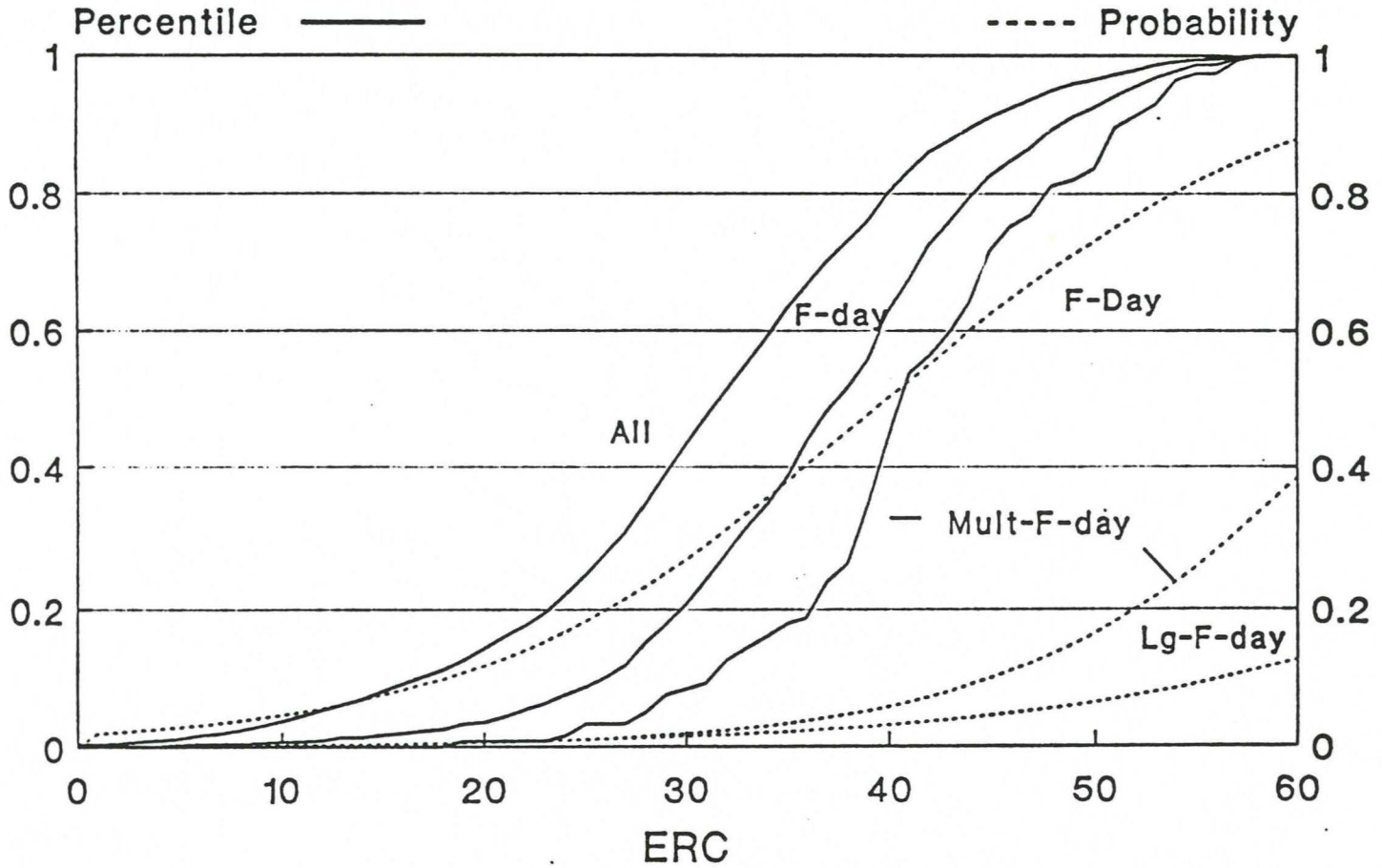
Structure the system so that a small team in each Region can create the tables for all areas in the Region.

(1) Develop and explain process--allow individual areas to perform analysis.
(2) Identify critical features, i.e., weather data collections prior to season,
(3) Determine minimum data points required for analysis.

Lolo NF (Montana)

Fuel Model G

1970-1985



HO1-VIIID-NFDRS

Lolo NF (70-85) Large Fire-Day Records (From Analysis File)

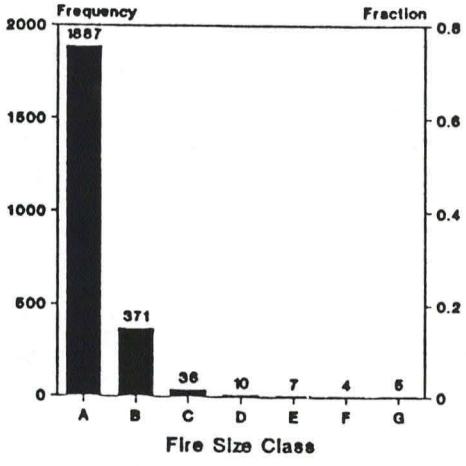
OBS	YEAR	MONTH	DAY	FIRES	LARFIRES	ERC-C	BI-C	ERC-G	FM1000
1	70	6	29	1	1	0	0	26	16
2	70	8	24	9	2	14	28	49	14
3	70	8	25	1	1	15	30	49	14
4	70	9	3	6	1	12	22	46	14
5	70	9	4	2	1	0	0	27	14
6	70	9	17	2	2	10	15	38	15
7	70	10	2	2	1	10	15	36	16
8	70	10	3	2	2	10	16	36	16
9	70	10	4	2	1	10	23	36	16
10	70	10	8	2	2	3	0	25	17
11	.71	8	6	5	1	4	10	41	13
12	72	9	1	5	1	11	18	44	14
13	73	5	2	1	1	16	36	31	19
14	73	5	19	2	1	4	10	37	16
15	73	5	22	4	1	5	12	39	16
16	73	5	24	1	1	2	6	35	16
17	73	7	12	1	1	15	29	52	14
18	73	7	13	3	1	13	28	51	14
19	73	8	4	8	1	17	47	58	12
20	73	8	9	1	1	18	48	57	12
21	73	8	13	44	1	16	34	55	12
22	73	8	16	7	2	18	49	57	12
23	74	7	2	4	1	8	19	46	13
24	74	8	7	2	1	4	10	35	15
25	74	9	7	1	1	10	17	41	15
26	74	9	18	1	1	9	19	37	16
27	74	9	27	1	1	2	5	28	16
28	75	8	5	5	1	7	12	40	15
29	75	9	14	1	1	5	6	31	18
30	75	9	25	2	1	6	12	32	18
31	76	9	5	4	1	9	14	40	16
32	78	6	5	2	1	4	5	23	22
33	78	8	11	2	1	13	30	46	14
34	78	8	13	1	1	1	4	33	14
35	78	9	3	2	1	7	17	34	17
36	79	5	20	1	1	4	7	32	18
37	79	6	12	2	1	4	6	41	15
38	79	7	17	2	1	5	11	39	15
39	79	7	20	14	1	7	11	43	14
40	79	7	21	6	1	6	10	42	14
41	79	8	9	1	1	6	13	42	14
42	79	8	11	3	1	6	10	41	14
43	79	8	20	8	1	2	5	32	15
44	79	9	12	1	1	2	4	28	17
45	79	9	16	2	1	5	6	33	17
46	79	9	19	1	1	3	6	32	17
47	79	9	26	2	1	1	5	27	17
48	79	10	11	5	1	3	5	28	17
49	80	10	5	3	1	7	13	31	17
50	80	10	12	2	1	0	0	22	17
51	81	8	24	15	2	9	22	50	12
52	81	8	25	10	1	9	22	51	12
53	81	8	26	32	1	9	19	51	12
54	82	9	19	1	1	5	15	30	17
55	84	7	16	2	2	5	10	39	15
56	84	8	28	8	1	7	21	41	15
57	84	8	29	6	1	7	23	41	15
58	85	5	27	1	1	2	4	31	16
59	85	7	1	2	1	8	13	42	16
60	85	7	7	2	1	9	18	44	15
61	85	7	10	2	1	10	15	45	14
62	85	7	17	4	1	11	23	47	14

YEAR	MONTH	DAY	WINDSPE	ERC-B	BI-B	ERC-G	FUELMOI4	BURNAREA	ELEV	CAUSE	SIZE	SLOPE
70	6	29	0	0	0	26	16	128	30	5	4	0
70	8	24	3	14	28	49	14	10	30	7	3	1
70	8	24	3	14	28	49	14	10	30	1	3	5
70	8	25	3	15	30	49	14	111	30	6	4	4
70	9	3	2	12	22	46	14	128	50	1	4	5
70	9	4	1	0	0	27	14	24	30	1	3	5
70	9	17	0	10	15	38	15	97	60	5	3	5
70	9	17	0	10	15	38	15	14	60	5	3	3
70	10	2	0	10	15	36	16	76	50	5	3	6
70	10	3	1	10	16	36	16	22	40	5	3	5
70	10	3	1	10	16	36	16	700	60	5	5	6
70	10	4	4	10	23	36	16	172	5	5	4	0
70	10	8	2	3	0	25	17	500	50	5	5	5
70	10	8	2	3	0	25	17	261	50	5	4	4
71	8	6	1	4	10	41	13	10	70	1	3	8
71	10	9	.	.	.	.	.	20	50	5	3	5
71	10	12	.	.	.	.	.	195	50	7	4	5
72	9	1	1	11	18	44	14	730	50	1	5	5
73	5	2	2	16	36	31	19	11	30	7	3	7
73	5	19	6	4	10	37	16	12	50	5	3	4
73	5	22	7	5	12	39	16	12	50	2	3	5
73	5	24	4	2	6	35	16	15	50	5	3	6
73	7	12	3	15	29	52	14	628	50	9	5	6
73	7	13	3	13	28	51	14	42	40	7	3	6
73	8	4	5	17	47	58	12	80	30	1	3	4
73	8	9	5	18	48	57	12	337	50	2	5	6
73	8	13	2	16	34	55	12	10	30	1	3	3
73	8	16	5	18	49	57	12	7290	30	9	7	0
73	8	16	5	18	49	57	12	30	30	9	3	3
73	10	5	.	.	.	.	.	60	40	5	3	5
74	7	2	3	8	19	46	13	200	50	5	4	5
74	8	7	2	4	10	35	15	30	30	9	3	3
74	9	7	1	10	17	41	15	14	20	2	3	0
74	9	18	2	9	19	37	16	24	50	5	3	6
74	9	27	2	2	5	28	16	65	40	3	3	2
74	10	1	.	.	.	.	.	10	60	5	3	6
74	10	17	.	.	.	.	.	34	60	9	3	3
74	10	18	.	.	.	.	.	64	50	5	3	6
75	6	10	.	.	.	.	.	60	40	5	3	6
75	8	5	0	7	12	40	15	130	50	2	4	4
75	9	14	0	5	6	31	18	50	60	5	3	7
75	9	25	3	6	12	32	18	95	50	5	3	5
76	9	5	0	9	14	40	16	90	60	5	3	6
76	10	14	.	.	.	.	.	15	30	1	3	6
78	6	5	1	4	5	23	22	15	40	5	3	4
78	8	11	4	13	30	46	14	177	60	2	4	3
78	8	13	1	1	4	33	14	13	60	1	3	7
78	9	3	2	7	17	34	17	30	60	5	3	3
79	5	20	4	4	7	32	18	20	50	2	3	5
79	6	12	1	4	6	41	15	17	60	9	3	2
79	7	17	2	5	11	39	15	480	30	2	5	6
79	7	20	0	7	11	43	14	39	40	1	3	8
79	7	21	0	6	10	42	14	302	30	4	5	6
79	8	9	1	6	13	42	14	1600	50	4	6	2
79	8	11	0	6	10	41	14	255	40	4	4	8
79	8	20	3	2	5	32	15	115	50	1	4	8
79	9	12	1	2	4	28	17	14	50	5	3	5
79	9	16	1	5	6	33	17	375	40	5	5	3
79	9	19	2	3	6	32	17	74	60	5	3	6
79	9	26	4	1	5	27	17	12	60	5	3	5
79	10	11	1	3	5	28	17	16	30	6	3	6
80	10	5	0	7	13	31	17	12	40	5	3	4
80	10	12	2	0	0	22	17	14	40	5	3	5
81	8	24	2	9	22	50	12	40	60	1	3	6
81	8	24	2	9	22	50	12	17	50	1	3	6
81	8	25	2	9	22	51	12	25	60	1	3	6
81	8	26	1	9	19	51	12	110	60	1	4	3
82	9	19	2	5	15	30	17	28	50	4	3	8
84	7	16	0	5	10	39	15	14	30	5	3	6
84	7	16	0	5	10	39	15	25	30	2	3	5
84	8	28	4	7	21	41	15	283	30	2	4	0
84	8	29	5	7	23	41	15	215	60	1	4	6
85	5	27	2	2	4	31	16	36	30	5	3	6
85	7	1	0	8	13	42	16	105	60	5	4	5
85	7	7	2	9	18	44	15	70	40	1	3	2
85	7	10	0	10	15	45	14	70	50	1	3	2
85	7	17	2	11	23	47	14	565	50	1	5	3

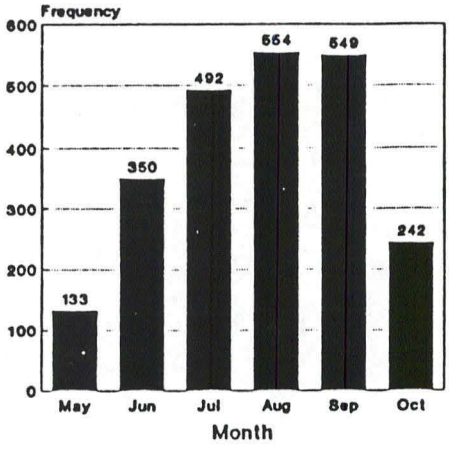
Frequencies, Percentiles, and Model Probabilities
Lolo NF (Montana): Fuel Model G, ERC (1970-1985)

	-- All Days --		----- Fire Days -----			-- Large Fire Days --			-- Multi Fire Days --		
ERC	N	P-Tile	N	P-Tile	Prob	N	P-Tile	Prob	N	P-Tile	Prob
0	11	0.00	1	0.00	0.00	0	0.00	0.00	0	0.00	0.00
1	1	0.00	0	0.00	0.02	0	0.00	0.00	0	0.00	0.00
2	1	0.01	0	0.00	0.02	0	0.00	0.00	0	0.00	0.00
3	7	0.01	0	0.00	0.02	0	0.00	0.00	0	0.00	0.00
4	5	0.01	0	0.00	0.03	0	0.00	0.00	0	0.00	0.00
5	7	0.01	2	0.00	0.03	0	0.00	0.00	0	0.00	0.00
6	12	0.02	2	0.01	0.03	0	0.00	0.00	0	0.00	0.00
7	7	0.02	0	0.01	0.04	0	0.00	0.00	0	0.00	0.00
8	12	0.03	0	0.01	0.04	0	0.00	0.00	0	0.00	0.00
9	16	0.03	1	0.01	0.04	0	0.00	0.00	0	0.00	0.00
10	17	0.04	1	0.01	0.05	0	0.00	0.00	0	0.00	0.00
11	20	0.05	0	0.01	0.05	0	0.00	0.00	0	0.00	0.00
12	21	0.05	2	0.01	0.06	0	0.00	0.00	0	0.00	0.00
13	19	0.06	4	0.01	0.06	0	0.00	0.00	0	0.00	0.00
14	20	0.07	0	0.01	0.07	0	0.00	0.00	0	0.00	0.00
15	29	0.08	3	0.02	0.08	0	0.00	0.01	0	0.00	0.00
16	25	0.09	2	0.02	0.08	0	0.00	0.01	0	0.00	0.00
17	26	0.10	3	0.02	0.09	0	0.00	0.01	0	0.00	0.00
18	30	0.11	3	0.03	0.10	0	0.00	0.01	0	0.00	0.01
19	34	0.13	7	0.03	0.11	0	0.00	0.01	1	0.01	0.01
20	43	0.15	2	0.04	0.12	0	0.00	0.01	0	0.01	0.01
21	44	0.16	8	0.05	0.13	0	0.00	0.01	0	0.01	0.01
22	37	0.18	9	0.06	0.14	1	0.02	0.01	0	0.01	0.01
23	48	0.20	9	0.07	0.16	1	0.03	0.01	0	0.01	0.01
24	61	0.22	11	0.08	0.17	0	0.03	0.01	1	0.02	0.01
25	70	0.25	10	0.09	0.18	1	0.05	0.01	2	0.03	0.01
26	75	0.28	12	0.10	0.20	1	0.06	0.01	0	0.03	0.01
27	73	0.31	17	0.12	0.22	2	0.10	0.01	0	0.03	0.01
28	99	0.35	29	0.15	0.23	3	0.15	0.01	2	0.05	0.02
29	106	0.39	22	0.18	0.25	0	0.15	0.01	3	0.08	0.02
30	108	0.43	27	0.21	0.27	1	0.16	0.02	1	0.09	0.02
31	98	0.47	31	0.24	0.29	4	0.23	0.02	1	0.09	0.02
32	100	0.51	33	0.28	0.31	4	0.29	0.02	4	0.13	0.02
33	94	0.55	32	0.31	0.33	2	0.32	0.02	2	0.15	0.03
34	103	0.59	29	0.35	0.36	1	0.34	0.02	2	0.16	0.03
35	103	0.63	35	0.39	0.38	2	0.37	0.02	2	0.18	0.03
36	84	0.67	45	0.44	0.40	3	0.42	0.02	1	0.19	0.04
37	87	0.70	40	0.48	0.43	2	0.45	0.03	6	0.24	0.04
38	75	0.73	32	0.52	0.45	1	0.47	0.03	3	0.26	0.05
39	75	0.76	39	0.56	0.48	3	0.52	0.03	10	0.35	0.05
40	101	0.80	62	0.63	0.50	2	0.55	0.03	11	0.44	0.06
41	79	0.83	43	0.68	0.53	6	0.65	0.03	11	0.54	0.07
42	73	0.86	46	0.73	0.55	3	0.69	0.04	3	0.56	0.07
43	42	0.88	29	0.76	0.58	1	0.71	0.04	4	0.60	0.08
44	43	0.90	30	0.79	0.60	2	0.74	0.04	5	0.64	0.09
45	41	0.91	30	0.83	0.62	1	0.76	0.05	9	0.72	0.10
46	33	0.93	19	0.85	0.65	3	0.81	0.05	4	0.75	0.11
47	30	0.94	18	0.87	0.67	1	0.82	0.05	2	0.77	0.12
48	31	0.95	24	0.89	0.69	0	0.82	0.06	5	0.81	0.14
49	25	0.96	17	0.91	0.71	2	0.85	0.06	1	0.82	0.15
50	16	0.97	12	0.93	0.73	1	0.87	0.07	2	0.84	0.17
51	17	0.97	14	0.94	0.75	3	0.92	0.07	7	0.90	0.18
52	15	0.98	13	0.96	0.77	1	0.94	0.08	2	0.91	0.20
53	18	0.99	11	0.97	0.79	0	0.94	0.08	2	0.93	0.22
54	11	0.99	8	0.98	0.80	0	0.94	0.09	4	0.97	0.24
55	8	0.99	8	0.99	0.82	1	0.95	0.09	1	0.97	0.26
56	1	0.99	0	0.99	0.83	0	0.95	0.10	0	0.97	0.28
57	8	1.00	7	0.99	0.85	2	0.98	0.11	2	0.99	0.31
58	5	1.00	4	1.00	0.86	1	1.00	0.11	1	1.00	0.33
59	1	1.00	1	1.00	0.87	0	1.00	0.12	0	1.00	0.36
60	0	1.00	0	1.00	0.88	0	1.00	0.13	0	1.00	0.39
	2501		899		0.36	62		0.02	117		0.05

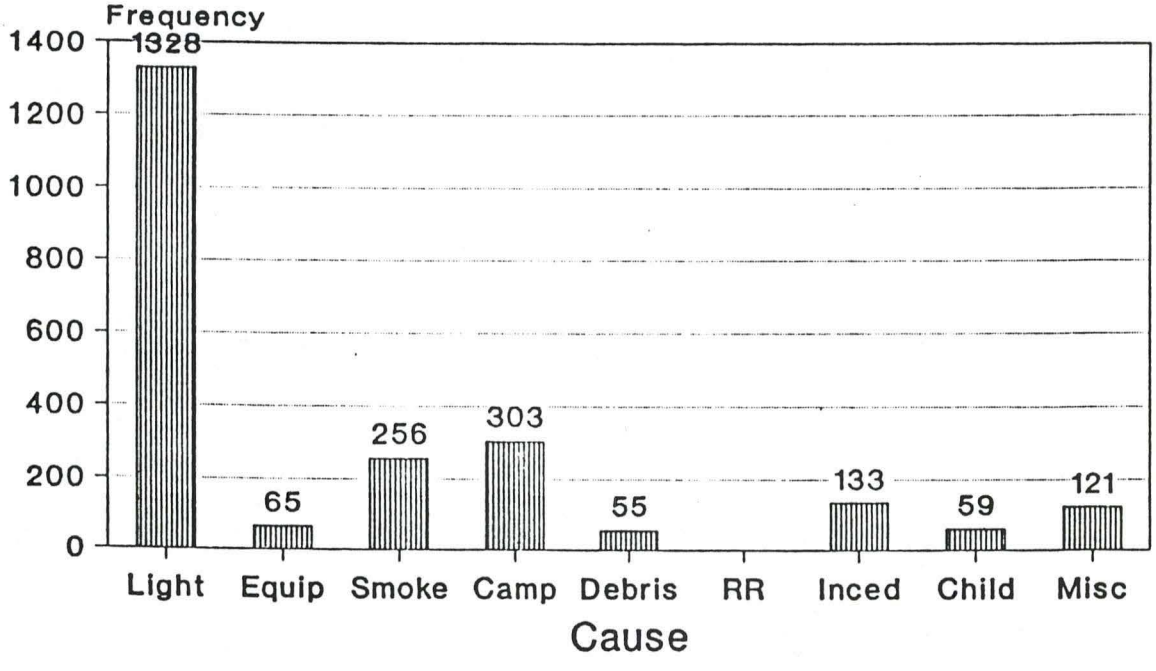
Stanislaus (California)
1970-1988
N=2320



Stanislaus (California)
1970-1988
N=2320



Stanislaus (California)
1970-1988
N=2320



Stanislaus NF (70-88) Large Fire Records (From Merge File)
(. = missing weather data)

OBS	YEAR	MONTH	DAY	WINDSPE	ERC-B	BI-B	FM1000	BURNAREA	ELEV	CAUSE	SIZE	SLOPE
1	70	6	23	.	.	.	.	15	20	5	3	6
2	70	10	17	.	.	.	.	448	10	4	5	8
3	71	8	12	.	.	.	.	25	50	1	3	0
4	72	6	8	.	.	.	.	50	30	1	3	1
5	72	6	19	.	.	.	.	115	20	7	4	6
6	72	7	15	.	.	.	.	544	30	3	5	6
7	72	9	24	.	.	.	.	672	20	9	5	7
8	73	5	15	.	.	.	.	20	40	1	3	0
9	73	5	20	.	.	.	.	235	40	4	4	0
10	73	6	14	.	.	.	.	60	20	9	3	0
11	73	8	7	.	.	.	.	75	60	1	3	0
12	73	8	17	.	.	.	.	25	30	7	3	0
13	73	8	17	.	.	.	.	17408	40	2	7	0
14	74	7	20	4	35	38	14	120	20	4	4	6
15	74	8	10	4	34	45	10	10	20	4	3	0
16	74	9	24	6	95	172	7	10	30	7	3	6
17	75	7	24	3	45	50	11	288	10	7	4	7
18	76	7	17	8	58	148	7	45	40	1	3	5
19	76	7	17	8	58	148	7	31	20	2	3	3
20	76	7	17	8	58	148	7	10	50	1	3	5
21	76	10	18	.	.	.	.	13	60	1	3	6
22	77	7	25	8	103	213	6	110	50	1	4	4
23	77	9	6	6	103	184	6	30	30	7	3	3
24	78	8	10	3	105	151	7	92	70	1	3	1
25	79	8	6	5	92	161	7	245	50	3	4	3
26	79	9	20	4	90	150	7	100	30	7	4	8
27	80	7	9	5	30	39	13	25	20	7	3	6
28	80	9	21	4	33	49	9	60	30	9	3	9
29	80	10	10	6	83	162	7	63	20	7	3	7
30	81	8	8	3	112	147	6	896	20	2	5	6
31	83	7	14	6	54	99	9	15	50	9	3	3
32	83	9	8	5	24	36	12	50	10	9	3	8
33	84	7	8	4	92	147	8	50	20	1	3	6
34	84	8	25	4	70	131	7	65	30	2	3	4
35	84	9	19	10	0	0	10	10	30	1	3	6
36	85	7	14	3	78	113	8	60	70	3	3	1
37	85	8	2	3	52	87	8	1008	10	9	6	8
38	85	8	10	3	80	117	8	145	30	2	4	4
39	85	8	31	3	77	122	8	304	30	7	5	8
40	86	7	15	6	63	134	8	75	33	7	3	3
41	86	8	12	3	96	143	7	20	35	3	3	3
42	87	7	31	7	74	159	8	30	60	2	3	1
43	87	8	28	3	97	132	7	544	48	2	5	1
44	87	8	29	2	92	120	7	1296	49	1	6	1
45	87	8	29	2	92	120	7	160	42	1	4	2
46	87	8	29	2	92	120	7	10	38	1	3	2
47	87	8	29	2	92	120	7	25	50	1	3	1
48	87	8	30	2	94	122	7	20	38	1	3	1
49	87	8	30	2	94	122	7	560	41	1	5	6
50	87	8	30	2	94	122	7	48128	52	1	7	3
51	87	8	30	2	94	122	7	30976	31	1	7	1
52	87	8	30	2	94	122	7	25	30	1	3	1
53	87	8	30	2	94	122	7	10	35	1	3	2
54	87	8	30	2	94	122	7	228	56	1	4	1
55	87	8	31	4	74	137	7	52736	31	1	7	6
56	87	9	2	0	51	58	7	8192	27	1	7	0
57	87	9	3	0	54	67	7	1744	48	1	6	3
58	87	10	12	3	12	25	6	10	62	1	3	6
59	88	7	2	3	66	92	10	2544	15	9	6	5
60	88	7	27	3	90	130	7	39	30	8	3	2
61	88	8	10	4	81	139	6	45	62	1	3	9
62	88	9	15	4	84	151	6	20	62	1	3	5

Stanislaus NF (74-88) Large Fire-Day Records (From Analysis File)

OBS	YEAR	MONTH	DAY	FIRES	LARFIRES	ERC-B	BI-B	FM1000
1	74	7	20	2	1	35	38	14
2	74	8	10	1	1	34	45	10
3	74	9	24	2	1	95	172	7
4	75	7	24	1	1	45	50	11
5	76	7	17	29	3	58	148	7
6	77	7	25	1	1	103	213	6
7	77	9	6	2	1	103	184	6
8	78	8	10	5	1	105	151	7
9	79	8	6	2	1	92	161	7
10	79	9	20	1	1	90	150	7
11	80	7	9	2	1	30	39	13
12	80	9	21	2	1	33	49	9
13	80	10	10	2	1	83	162	7
14	81	8	8	3	1	112	147	6
15	83	7	14	1	1	54	99	9
16	83	9	8	2	1	24	36	12
17	84	7	8	1	1	92	147	8
18	84	8	25	1	1	70	131	7
19	84	9	19	22	1	0	0	10
20	85	7	14	2	1	78	113	8
21	85	8	2	1	1	52	87	8
22	85	8	10	1	1	80	117	8
23	85	8	31	2	1	77	122	8
24	86	7	15	1	1	63	134	8
25	86	8	12	1	1	96	143	7
26	87	7	31	2	1	74	159	8
27	87	8	28	1	1	97	132	7
28	87	8	29	19	4	92	120	7
29	87	8	30	27	7	94	122	7
30	87	8	31	8	1	74	137	7
31	87	9	2	1	1	51	58	7
32	87	9	3	3	1	54	67	7
33	87	10	12	20	1	12	25	6
34	88	7	2	1	1	66	92	10
35	88	7	27	2	1	90	130	7
36	88	8	10	2	1	81	139	6
37	88	9	15	2	1	84	151	6

	All Days		Fire Days			Large Fire Days			Multiple Fire Days		
BI	N	P-Tile	N	P-Tile	Prob	N	P-Tile	Prob	N	P-Tile	Prob
0	87	0.04	20	0.02	0.21	1	0.03	0.00	2	0.03	0.01
2	2	0.04	1	0.03	0.21	0	0.03	0.00	0	0.03	0.01
3	1	0.04	0	0.03	0.21	0	0.03	0.00	0	0.03	0.01
4	4	0.04	0	0.03	0.21	0	0.03	0.00	0	0.03	0.01
5	2	0.04	0	0.03	0.22	0	0.03	0.00	0	0.03	0.01
6	2	0.04	0	0.03	0.22	0	0.03	0.00	0	0.03	0.01
7	4	0.04	0	0.03	0.22	0	0.03	0.00	0	0.03	0.01
8	1	0.04	1	0.03	0.22	0	0.03	0.00	0	0.03	0.01
9	2	0.05	1	0.03	0.22	0	0.03	0.00	0	0.03	0.01
10	2	0.05	0	0.03	0.22	0	0.03	0.00	0	0.03	0.01
11	5	0.05	1	0.03	0.23	0	0.03	0.00	0	0.03	0.01
12	6	0.05	2	0.03	0.23	0	0.03	0.00	0	0.03	0.01
13	4	0.05	1	0.03	0.23	0	0.03	0.00	0	0.03	0.01
14	9	0.06	3	0.04	0.23	0	0.03	0.00	0	0.03	0.01
15	5	0.06	2	0.04	0.23	0	0.03	0.00	0	0.03	0.01
16	11	0.06	7	0.05	0.24	0	0.03	0.00	2	0.06	0.01
17	9	0.07	2	0.05	0.24	0	0.03	0.00	1	0.07	0.01
18	11	0.07	1	0.05	0.24	0	0.03	0.00	0	0.07	0.01
19	11	0.08	2	0.05	0.24	0	0.03	0.00	0	0.07	0.01
20	12	0.08	2	0.05	0.24	0	0.03	0.00	0	0.07	0.01
21	13	0.09	1	0.06	0.25	0	0.03	0.00	0	0.07	0.01
22	11	0.09	2	0.06	0.25	0	0.03	0.00	0	0.07	0.01
23	12	0.10	4	0.06	0.25	0	0.03	0.00	0	0.07	0.01
24	16	0.10	5	0.07	0.25	0	0.03	0.00	0	0.07	0.01
25	27	0.12	5	0.08	0.25	1	0.05	0.00	2	0.10	0.01
26	19	0.12	4	0.08	0.26	0	0.05	0.00	0	0.10	0.01
27	25	0.14	6	0.09	0.26	0	0.05	0.00	0	0.10	0.01
28	30	0.15	14	0.10	0.26	0	0.05	0.00	3	0.14	0.01
29	26	0.16	7	0.11	0.26	0	0.05	0.00	0	0.14	0.01
30	40	0.18	4	0.12	0.26	0	0.05	0.01	0	0.14	0.01
31	37	0.19	8	0.13	0.27	0	0.05	0.01	0	0.14	0.01
32	52	0.22	16	0.15	0.27	0	0.05	0.01	1	0.16	0.01
33	43	0.23	13	0.16	0.27	0	0.05	0.01	1	0.17	0.01
34	51	0.26	17	0.18	0.27	0	0.05	0.01	2	0.20	0.01
35	36	0.27	8	0.19	0.27	0	0.05	0.01	0	0.20	0.01
36	51	0.29	16	0.21	0.28	1	0.08	0.01	1	0.22	0.02
37	50	0.32	14	0.23	0.28	0	0.08	0.01	3	0.26	0.02
38	54	0.34	22	0.25	0.28	1	0.11	0.01	1	0.28	0.02
39	61	0.36	21	0.28	0.28	1	0.14	0.01	3	0.32	0.02
40	44	0.38	12	0.29	0.28	0	0.14	0.01	1	0.33	0.02
41	57	0.41	18	0.31	0.29	0	0.14	0.01	1	0.35	0.02
42	47	0.43	15	0.33	0.29	0	0.14	0.01	1	0.36	0.02
43	30	0.44	7	0.34	0.29	0	0.14	0.01	1	0.38	0.02
44	34	0.46	9	0.35	0.29	0	0.14	0.01	0	0.38	0.02
45	28	0.47	7	0.36	0.30	1	0.16	0.01	1	0.39	0.02
46	34	0.48	11	0.37	0.30	0	0.16	0.01	0	0.39	0.02
47	24	0.49	10	0.38	0.30	0	0.16	0.01	0	0.39	0.02
48	25	0.50	7	0.39	0.30	0	0.16	0.01	1	0.41	0.02
49	28	0.52	8	0.40	0.30	1	0.19	0.01	1	0.42	0.02
50	12	0.52	4	0.41	0.31	1	0.22	0.01	1	0.43	0.02
51	16	0.53	3	0.41	0.31	0	0.22	0.01	0	0.43	0.02
52	7	0.53	3	0.41	0.31	0	0.22	0.01	1	0.45	0.02
53	11	0.54	4	0.42	0.31	0	0.22	0.01	0	0.45	0.02
54	13	0.54	6	0.43	0.32	0	0.22	0.01	0	0.45	0.02
55	7	0.55	2	0.43	0.32	0	0.22	0.01	0	0.45	0.02

	All Days		Fire Days			Large Fire Days			Multiple Fire Days		
BI	N	P-Tile	N	P-Tile	Prob	N	P-Tile	Prob	N	P-Tile	Prob
56	8	0.55	4	0.43	0.32	0	0.22	0.01	0	0.45	0.02
57	7	0.55	3	0.44	0.32	0	0.22	0.01	0	0.45	0.02
58	8	0.55	5	0.44	0.32	1	0.24	0.01	0	0.45	0.02
59	7	0.56	4	0.45	0.33	0	0.24	0.01	3	0.49	0.02
60	5	0.56	2	0.45	0.33	0	0.24	0.01	0	0.49	0.02
61	6	0.56	4	0.46	0.33	0	0.24	0.01	0	0.49	0.02
62	5	0.56	1	0.46	0.33	0	0.24	0.01	0	0.49	0.02
63	9	0.57	6	0.46	0.34	0	0.24	0.01	0	0.49	0.02
64	5	0.57	1	0.46	0.34	0	0.24	0.01	0	0.49	0.02
65	4	0.57	1	0.47	0.34	0	0.24	0.01	0	0.49	0.02
66	5	0.57	2	0.47	0.34	0	0.24	0.01	0	0.49	0.02
67	9	0.58	4	0.47	0.35	1	0.27	0.01	0	0.49	0.02
68	6	0.58	4	0.48	0.35	0	0.27	0.01	0	0.49	0.02
69	8	0.58	4	0.48	0.35	0	0.27	0.01	1	0.51	0.02
70	7	0.59	1	0.48	0.35	0	0.27	0.01	0	0.51	0.02
71	3	0.59	1	0.49	0.35	0	0.27	0.01	0	0.51	0.02
72	5	0.59	1	0.49	0.36	0	0.27	0.01	0	0.51	0.02
73	3	0.59	2	0.49	0.36	0	0.27	0.01	0	0.51	0.02
74	6	0.60	3	0.49	0.36	0	0.27	0.01	0	0.51	0.02
75	16	0.60	6	0.50	0.36	0	0.27	0.01	0	0.51	0.02
76	10	0.61	6	0.51	0.37	0	0.27	0.01	0	0.51	0.02
77	6	0.61	4	0.51	0.37	0	0.27	0.01	0	0.51	0.02
78	9	0.61	2	0.51	0.37	0	0.27	0.01	0	0.51	0.03
79	5	0.61	1	0.51	0.37	0	0.27	0.01	0	0.51	0.03
80	13	0.62	6	0.52	0.38	0	0.27	0.01	1	0.52	0.03
81	11	0.63	4	0.53	0.38	0	0.27	0.01	1	0.54	0.03
82	5	0.63	1	0.53	0.38	0	0.27	0.01	0	0.54	0.03
83	12	0.63	5	0.53	0.38	0	0.27	0.01	0	0.54	0.03
84	9	0.64	5	0.54	0.39	0	0.27	0.01	0	0.54	0.03
85	9	0.64	2	0.54	0.39	0	0.27	0.01	0	0.54	0.03
86	10	0.64	5	0.55	0.39	0	0.27	0.01	0	0.54	0.03
87	10	0.65	4	0.55	0.39	1	0.30	0.01	0	0.54	0.03
88	10	0.65	5	0.56	0.40	0	0.30	0.01	0	0.54	0.03
89	10	0.66	2	0.56	0.40	0	0.30	0.01	0	0.54	0.03
90	3	0.66	1	0.56	0.40	0	0.30	0.01	0	0.54	0.03
91	6	0.66	3	0.57	0.40	0	0.30	0.01	0	0.54	0.03
92	11	0.67	3	0.57	0.41	1	0.32	0.01	0	0.54	0.03
93	12	0.67	6	0.58	0.41	0	0.32	0.01	0	0.54	0.03
94	6	0.67	2	0.58	0.41	0	0.32	0.01	1	0.55	0.03
95	12	0.68	4	0.58	0.41	0	0.32	0.02	0	0.55	0.03
96	8	0.68	6	0.59	0.42	0	0.32	0.02	0	0.55	0.03
97	8	0.69	5	0.60	0.42	0	0.32	0.02	0	0.55	0.03
98	5	0.69	2	0.60	0.42	0	0.32	0.02	0	0.55	0.03
99	11	0.69	4	0.60	0.42	1	0.35	0.02	1	0.57	0.03
100	14	0.70	7	0.61	0.43	0	0.35	0.02	0	0.57	0.03
101	5	0.70	2	0.62	0.43	0	0.35	0.02	0	0.57	0.03
102	8	0.70	4	0.62	0.43	0	0.35	0.02	0	0.57	0.03
103	9	0.71	3	0.62	0.43	0	0.35	0.02	0	0.57	0.03
104	12	0.71	6	0.63	0.44	0	0.35	0.02	1	0.58	0.03
105	11	0.72	3	0.63	0.44	0	0.35	0.02	0	0.58	0.03
106	5	0.72	1	0.64	0.44	0	0.35	0.02	0	0.58	0.04
107	13	0.73	5	0.64	0.45	0	0.35	0.02	1	0.[illegible]	0.04
108	10	0.73	5	0.65	0.45	0	0.35	0.02	0	0.[illegible]	0.04
109	5	0.73	2	0.65	0.45	0	0.35	0.02	0	0.[illegible]	0.04
110	11	0.74	3	0.65	0.45	0	0.35	0.02	0	0.59	0.04

Frequencies, Percentiles and Model Probabilities
Stanislaus NF (California): Fuel Model B, BI (1970-1988)

	All Days		Fire Days			Large Fire Days			Multiple Fire Days		
BI	N	P-Tile	N	P-Tile	Prob	N	P-Tile	Prob	N	P-Tile	Prob
111	8	0.74	3	0.66	0.46	0	0.35	0.02	0	0.59	0.04
112	8	0.74	5	0.66	0.46	0	0.35	0.02	1	0.61	0.04
113	15	0.75	11	0.68	0.46	1	0.38	0.02	1	0.62	0.04
114	12	0.76	5	0.68	0.46	0	0.38	0.02	1	0.64	0.04
115	12	0.76	7	0.69	0.47	0	0.38	0.02	0	0.64	0.04
116	12	0.77	2	0.69	0.47	0	0.38	0.02	1	0.65	0.04
117	8	0.77	6	0.70	0.47	1	0.41	0.02	0	0.65	0.04
118	9	0.77	5	0.71	0.47	0	0.41	0.02	0	0.65	0.04
119	8	0.78	2	0.71	0.48	0	0.41	0.02	0	0.65	0.04
120	5	0.78	1	0.71	0.48	1	0.43	0.02	1	0.67	0.04
121	7	0.78	4	0.71	0.48	0	0.43	0.02	1	0.68	0.04
122	9	0.79	6	0.72	0.48	2	0.49	0.02	1	0.70	0.04
123	10	0.79	8	0.73	0.49	0	0.49	0.02	0	0.70	0.04
124	10	0.80	4	0.74	0.49	0	0.49	0.02	2	0.72	0.04
125	16	0.80	5	0.74	0.49	0	0.49	0.03	0	0.72	0.04
126	19	0.81	7	0.75	0.49	0	0.49	0.03	1	0.74	0.04
127	10	0.81	2	0.75	0.50	0	0.49	0.03	1	0.75	0.05
128	5	0.82	3	0.76	0.50	0	0.49	0.03	0	0.75	0.05
129	6	0.82	0	0.76	0.50	0	0.49	0.03	0	0.75	0.05
130	15	0.83	6	0.76	0.51	1	0.51	0.03	1	0.77	0.05
131	16	0.83	10	0.78	0.51	1	0.54	0.03	0	0.77	0.05
132	13	0.84	7	0.78	0.51	1	0.57	0.03	0	0.77	0.05
133	11	0.84	5	0.79	0.51	0	0.57	0.03	0	0.77	0.05
134	10	0.85	7	0.80	0.52	1	0.59	0.03	0	0.77	0.05
135	14	0.85	6	0.81	0.52	0	0.59	0.03	0	0.77	0.05
136	4	0.86	1	0.81	0.52	0	0.59	0.03	0	0.77	0.05
137	9	0.86	4	0.81	0.52	1	0.62	0.03	1	0.78	0.05
138	7	0.86	3	0.81	0.53	0	0.62	0.03	0	0.78	0.05
139	11	0.87	6	0.82	0.53	1	0.65	0.03	0	0.78	0.05
140	6	0.87	5	0.83	0.53	0	0.65	0.03	1	0.80	0.05
141	8	0.87	3	0.83	0.53	0	0.65	0.03	0	0.80	0.05
142	8	0.88	3	0.84	0.54	0	0.65	0.03	0	0.80	0.05
143	13	0.88	8	0.84	0.54	1	0.68	0.03	1	0.81	0.05
144	6	0.88	3	0.85	0.54	0	0.68	0.03	0	0.81	0.06
145	8	0.89	3	0.85	0.54	0	0.68	0.04	1	0.83	0.06
146	9	0.89	9	0.86	0.55	0	0.68	0.04	1	0.84	0.06
147	7	0.89	5	0.87	0.55	2	0.73	0.04	0	0.84	0.06
148	7	0.90	4	0.87	0.55	1	0.76	0.04	1	0.86	0.06
149	8	0.90	4	0.88	0.56	0	0.76	0.04	0	0.86	0.06
150	13	0.91	6	0.89	0.56	1	0.78	0.04	1	0.87	0.06
151	15	0.91	11	0.90	0.56	2	0.84	0.04	2	0.90	0.06
152	9	0.92	5	0.90	0.56	0	0.84	0.04	0	0.90	0.06
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154	5	0.92	5	0.92	0.57	0	0.84	0.04	2	0.93	0.06
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158	7	0.93	6	0.93	0.58	0	0.84	0.04	0	0.93	0.07
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161	7	0.94	6	0.94	0.59	1	0.89	0.05	1	0.94	0.07
162	8	0.95	5	0.95	0.59	1	0.92	0.05	0	0.94	0.07
163	4	0.95	1	0.95	0.59	0	0.92	0.05	0	0.94	0.07
164	3	0.95	0	0.95	0.59	0	0.92	0.05	0	0.94	0.07
165	6	0.95	4	0.95	0.60	0	0.92	0.05	2	0.97	0.07
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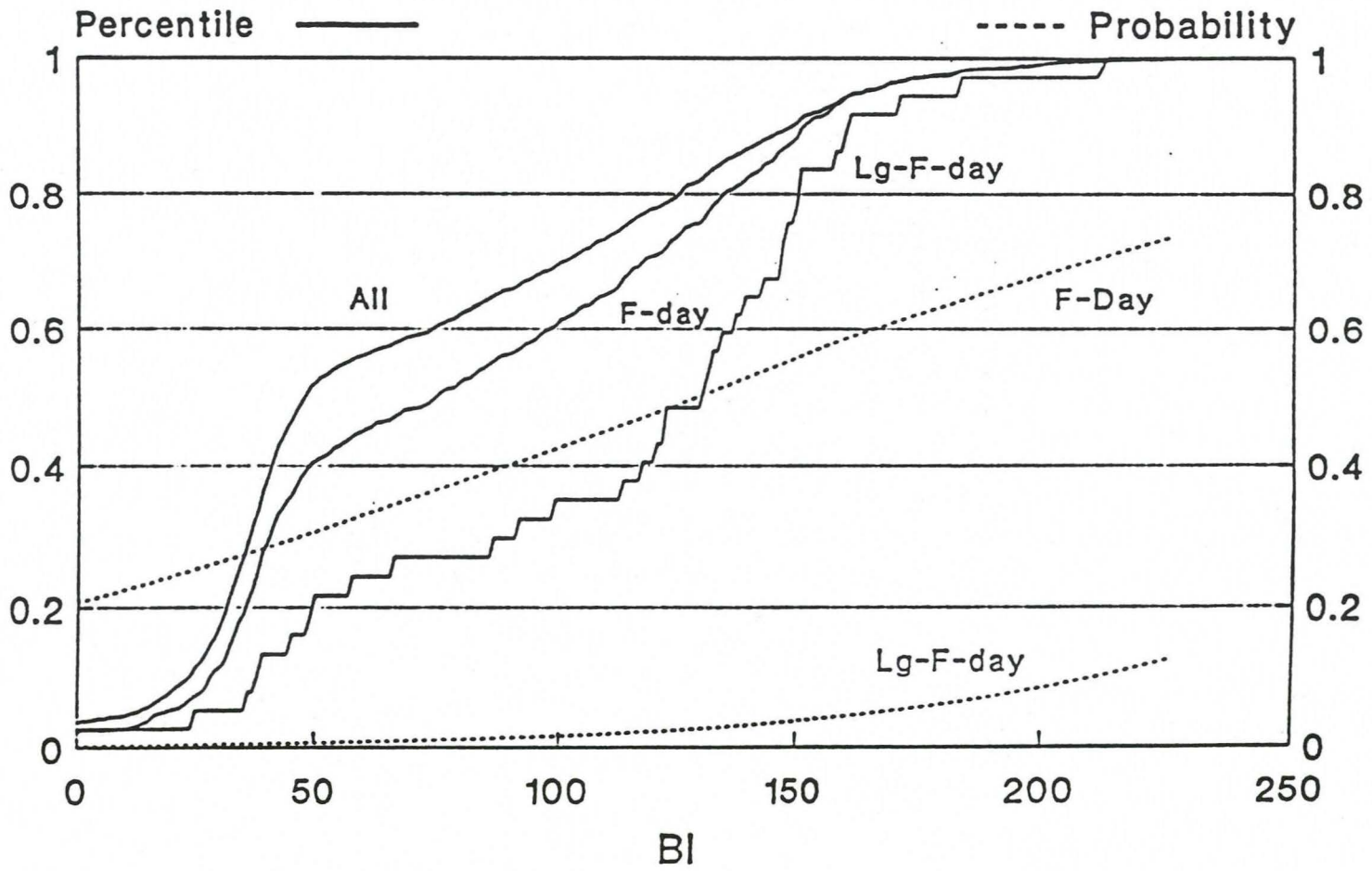
167	4	0.96	1	0.96	0.60	0	0.92	0.05	0	0.97	0.07
168	6	0.96	1	0.96	0.60	0	0.92	0.05	0	0.97	0.07
169	7	0.96	4	0.96	0.61	0	0.92	0.05	2	1.00	0.07
170	8	0.96	2	0.96	0.61	0	0.92	0.05	0	1.00	0.08
171	3	0.97	1	0.97	0.61	0	0.92	0.05	0	1.00	0.08
172	3	0.97	1	0.97	0.61	1	0.95	0.05	0	1.00	0.08
173	5	0.97	1	0.97	0.62	0	0.95	0.06	0	1.00	0.08
174	5	0.97	3	0.97	0.62	0	0.95	0.06	0	1.00	0.08
175	3	0.97	0	0.97	0.62	0	0.95	0.06	0	1.00	0.08
177	3	0.97	1	0.97	0.63	0	0.95	0.06	0	1.00	0.08
178	4	0.98	1	0.97	0.63	0	0.95	0.06	0	1.00	0.08
179	2	0.98	0	0.97	0.63	0	0.95	0.06	0	1.00	0.08
180	2	0.98	0	0.97	0.63	0	0.95	0.06	0	1.00	0.08
181	1	0.98	0	0.97	0.64	0	0.95	0.06	0	1.00	0.09
182	2	0.98	1	0.97	0.64	0	0.95	0.06	0	1.00	0.09
183	4	0.98	3	0.98	0.64	0	0.95	0.07	0	1.00	0.09
184	4	0.98	3	0.98	0.64	1	0.97	0.07	0	1.00	0.09
185	2	0.98	1	0.98	0.65	0	0.97	0.07	0	1.00	0.09
186	3	0.98	0	0.98	0.65	0	0.97	07	0	1.00	0.09
188	2	0.99	1	0.98	0.65	0	0.97	0.07	0	1.00	0.09
190	2	0.99	0	0.98	0.66	0	0.97	0.07	0	1.00	0.09
192	2	0.99	0	0.98	0.66	0	0.97	0.08	0	1.00	0.10
194	1	0.99	0	0.98	0.67	0	0.97	0.08	0	1.00	0.10
195	2	0.99	1	0.99	0.67	0	0.97	0.08	0	1.00	0.10
196	3	0.99	1	0.99	0.67	0	0.97	0.08	0	1.00	0.10
198	1	0.99	1	0.99	0.68	0	0.97	0.08	0	1.00	0.10
199	1	0.99	1	0.99	0.68	0	0.97	0.08	0	1.00	0.10
200	1	0.99	1	0.99	0.68	0	0.97	0.09	0	1.00	0.11
201	2	0.99	1	0.99	0.68	0	0.97	0.09	0	1.00	0.11
202	2	0.99	1	0.99	0.69	0	0.97	0.09	0	1.00	0.11
203	2	0.99	1	0.99	0.69	0	0.97	0.09	0	1.00	0.11
204	2	0.99	0	0.99	0.69	0	0.97	0.09	0	1.00	0.11
205	1	1.00	0	0.99	0.69	0	0.97	0.09	0	1.00	0.11
211	2	1.00	1	1.00	0.71	0	0.97	0.10	0	1.00	0.12
213	2	1.00	1	1.00	0.71	1	1.00	0.11	0	1.00	0.12
214	1	1.00	1	1.00	0.71	0	1.00	0.11	0	1.00	0.12
216	1	1.00	1	1.00	0.72	0	1.00	0.11	0	1.00	0.13
218	1	1.00	1	1.00	0.72	0	1.00	0.11	0	1.00	0.13
221	1	1.00	0	1.00	0.73	0	1.00	0.12	0	1.00	0.13
224	1	1.00	0	1.00	0.73	0	1.00	0.12	0	1.00	0.14
225	1	1.00	0	1.00	0.73	0	1.00	0.13	0	1.00	0.14
226	1	1.00	0	1.00	0.74	0	1.00	0.13	0	1.00	0.14
	2314		837		.36	37		.02	69		.05

Stanislaus (California)

Fuel Model B

1970-1988



Appendix C

Region 1 Polygon Analysis

Cumulative and Probability Distributions

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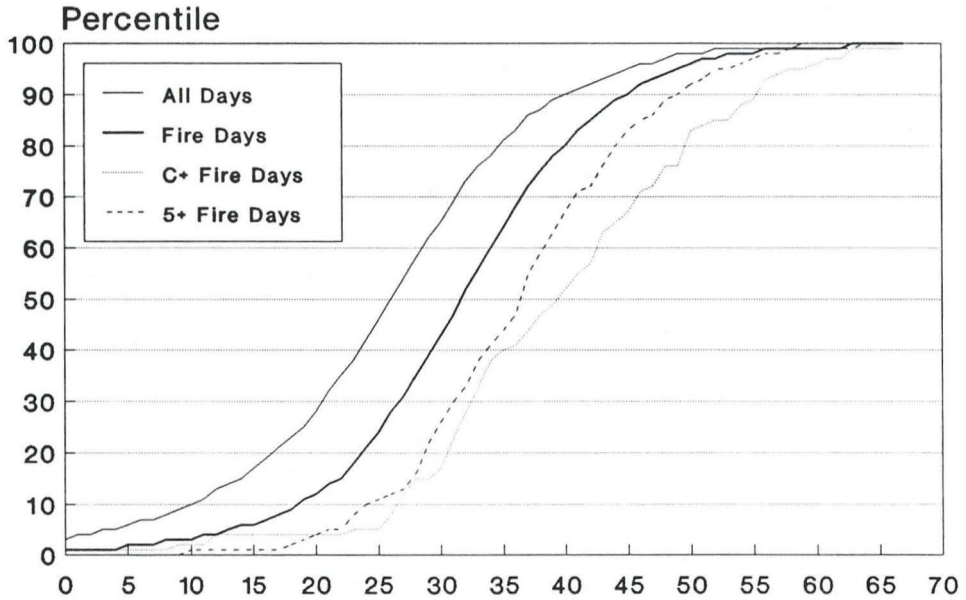

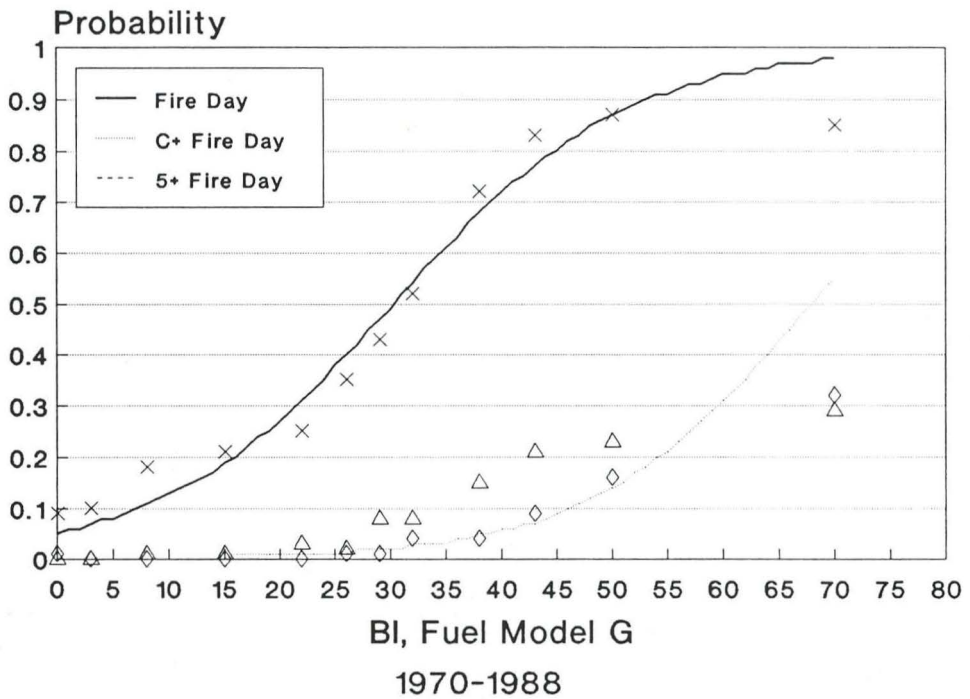

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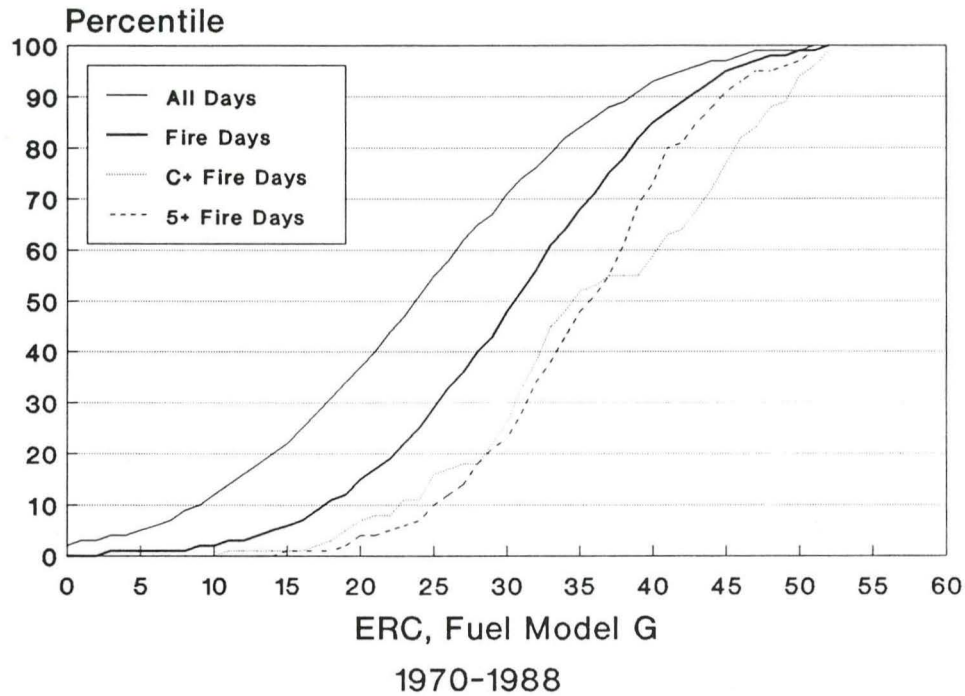

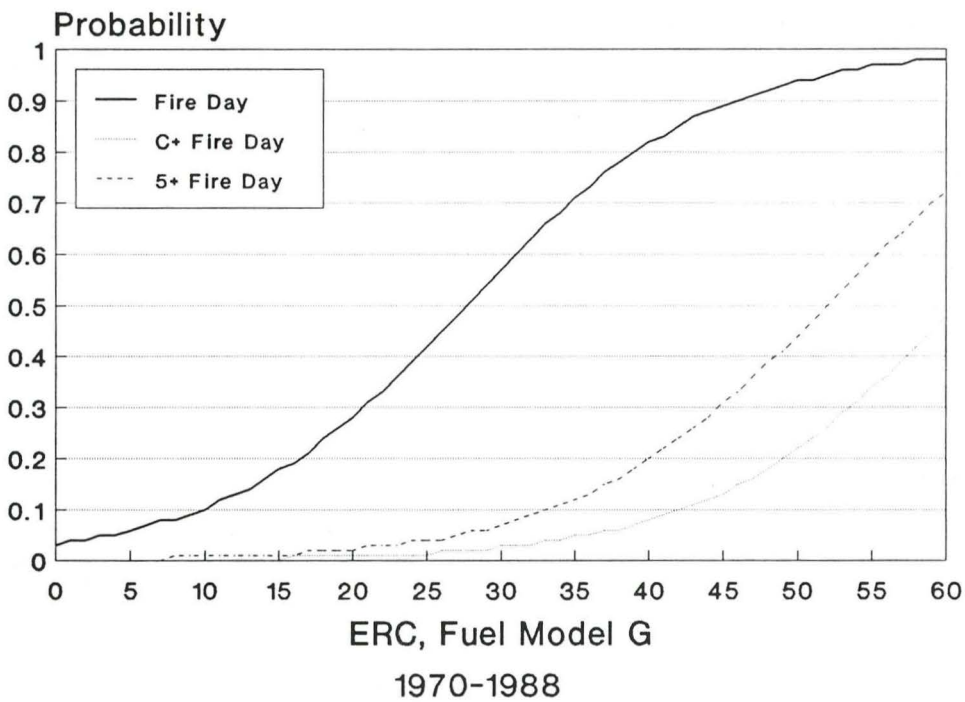

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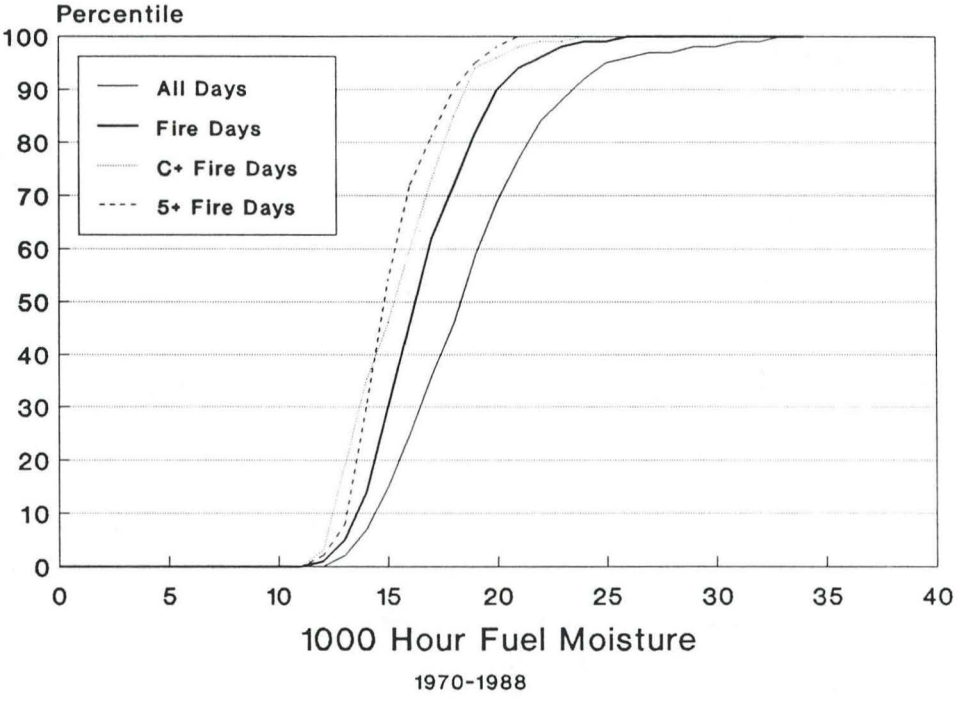

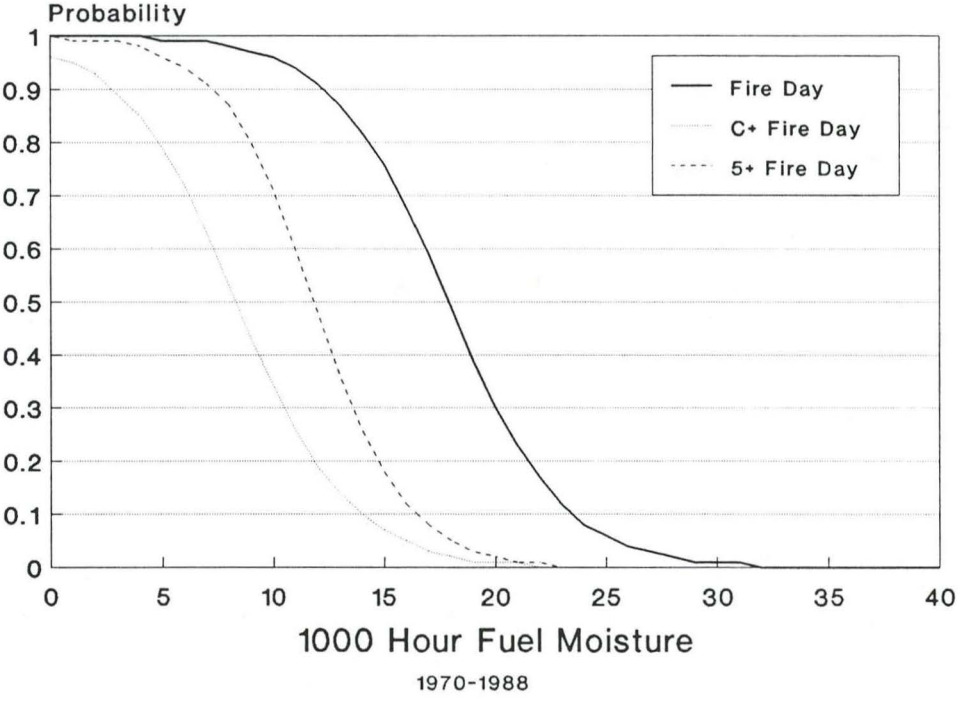

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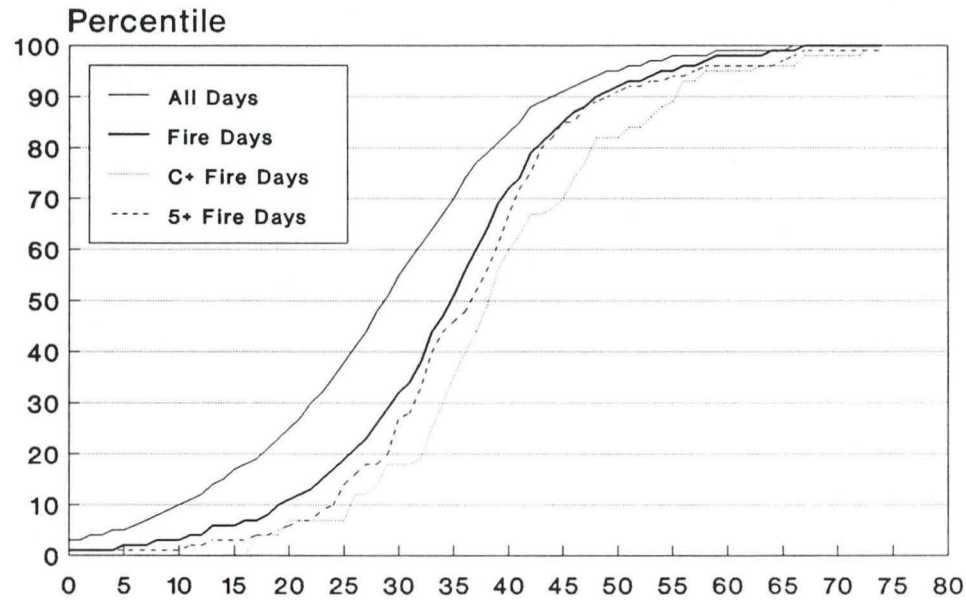

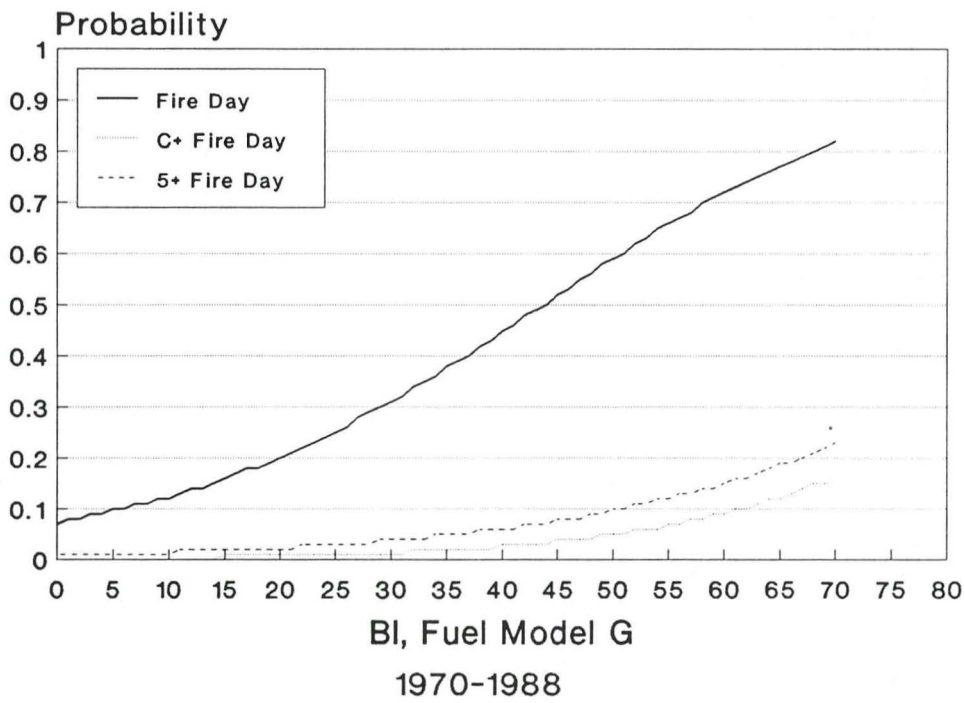

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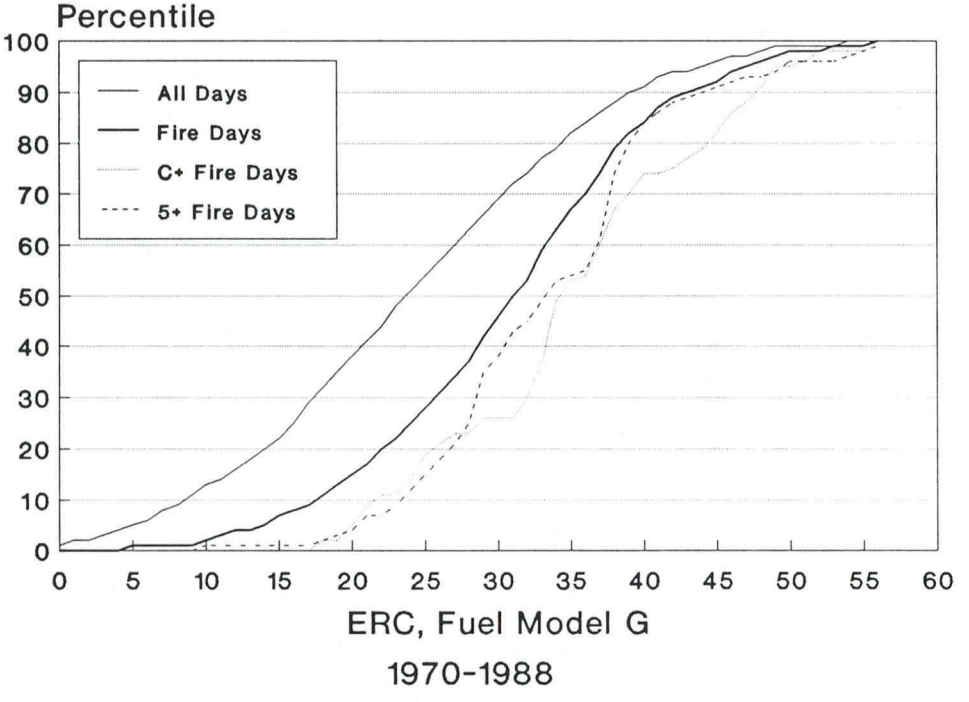

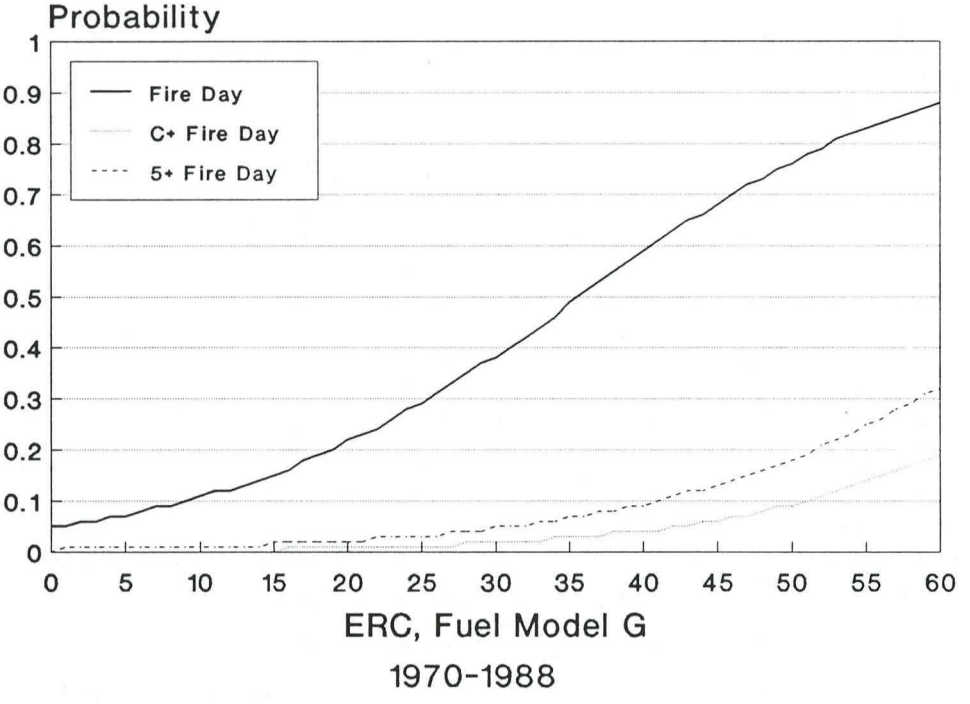

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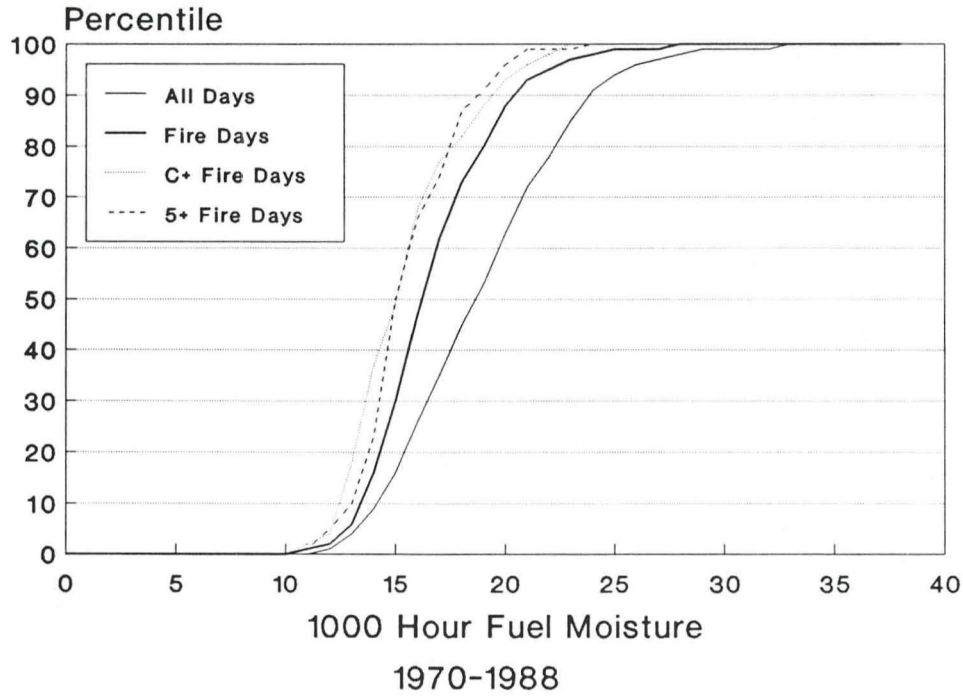

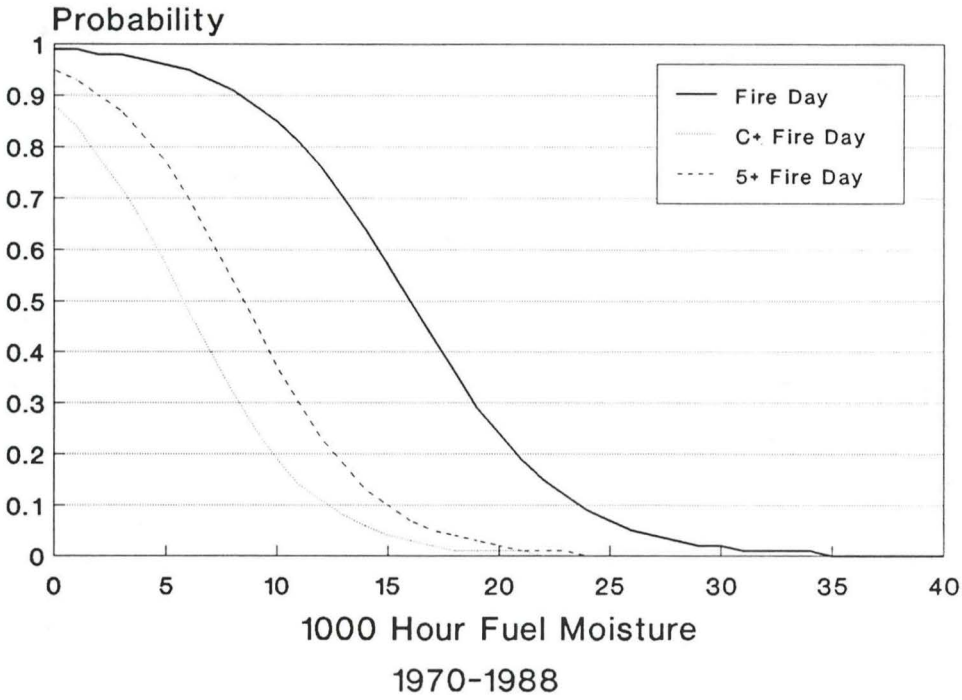

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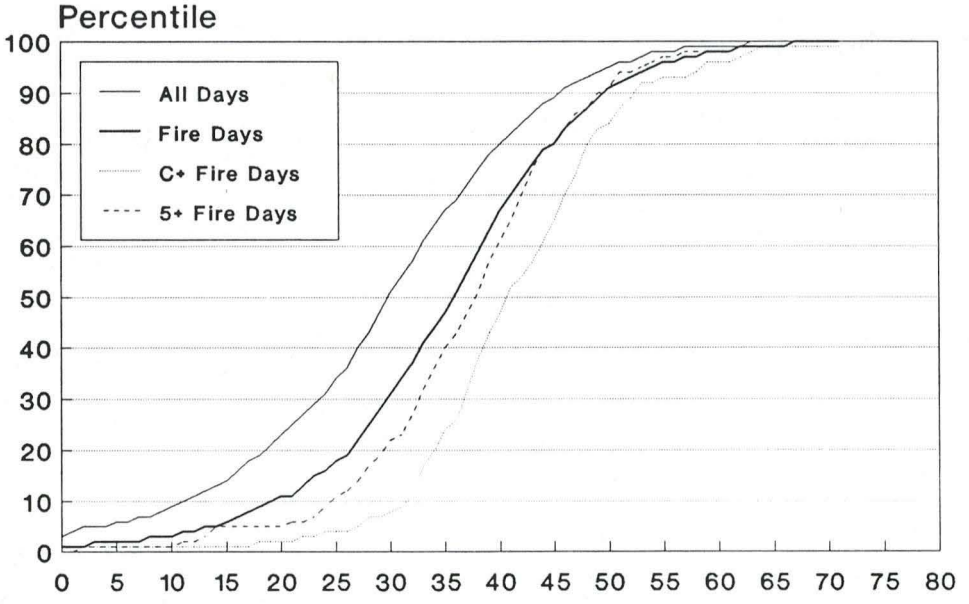

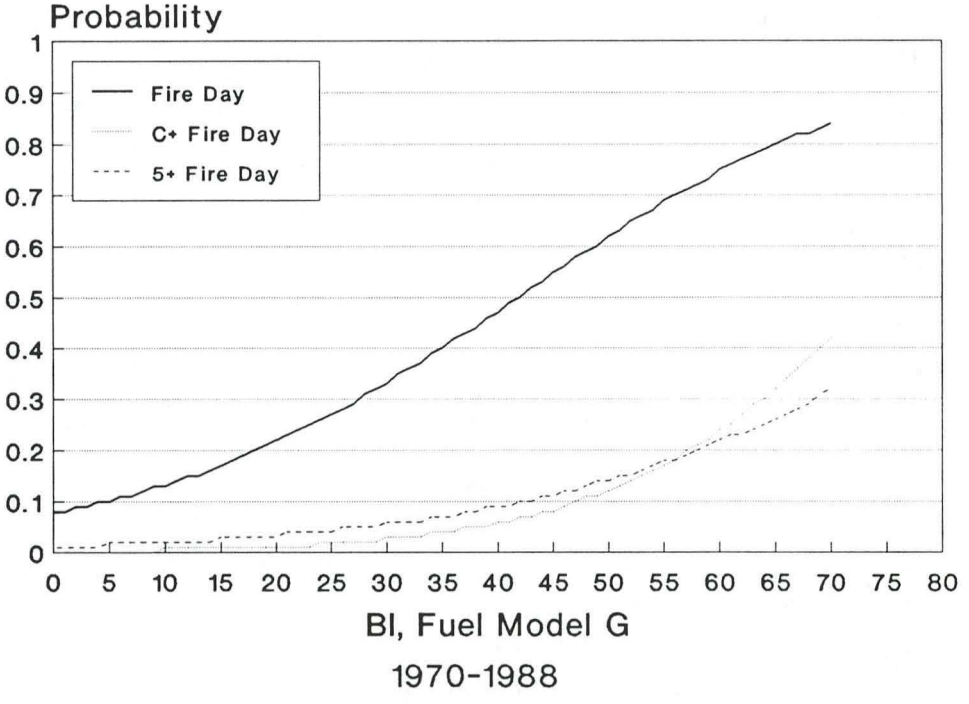

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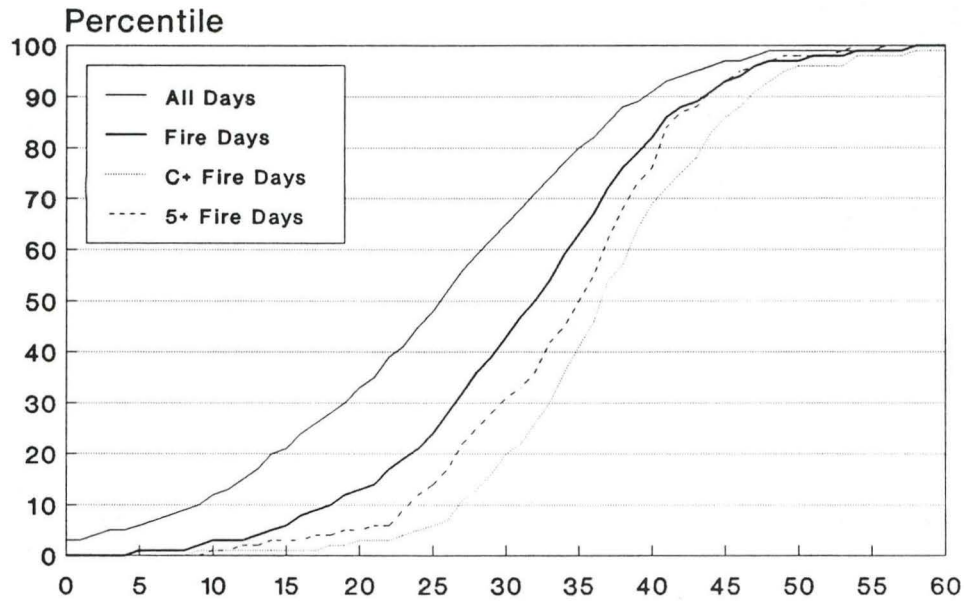

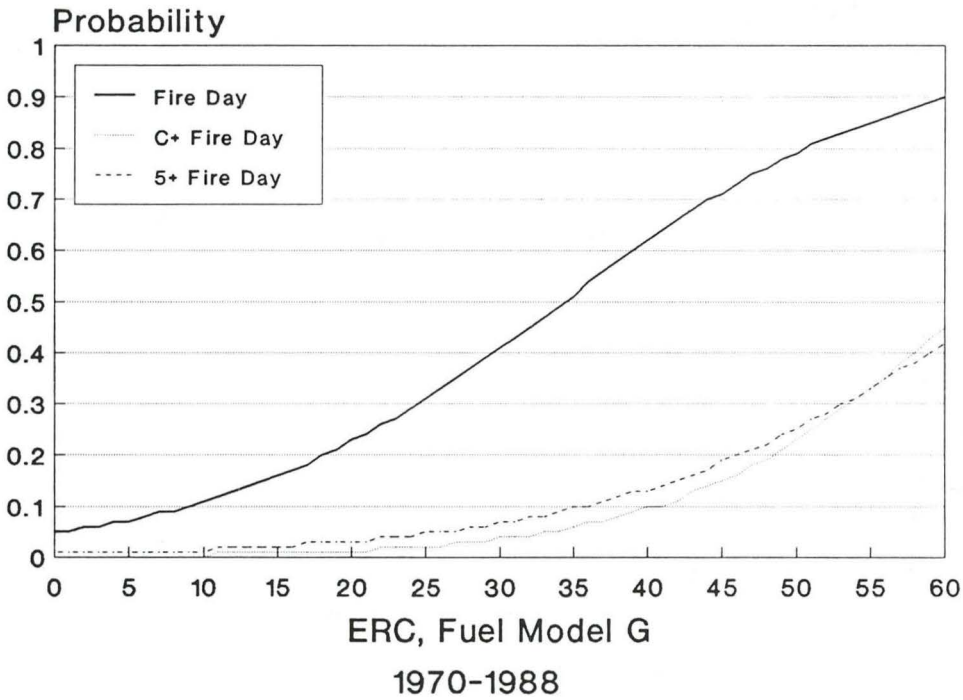

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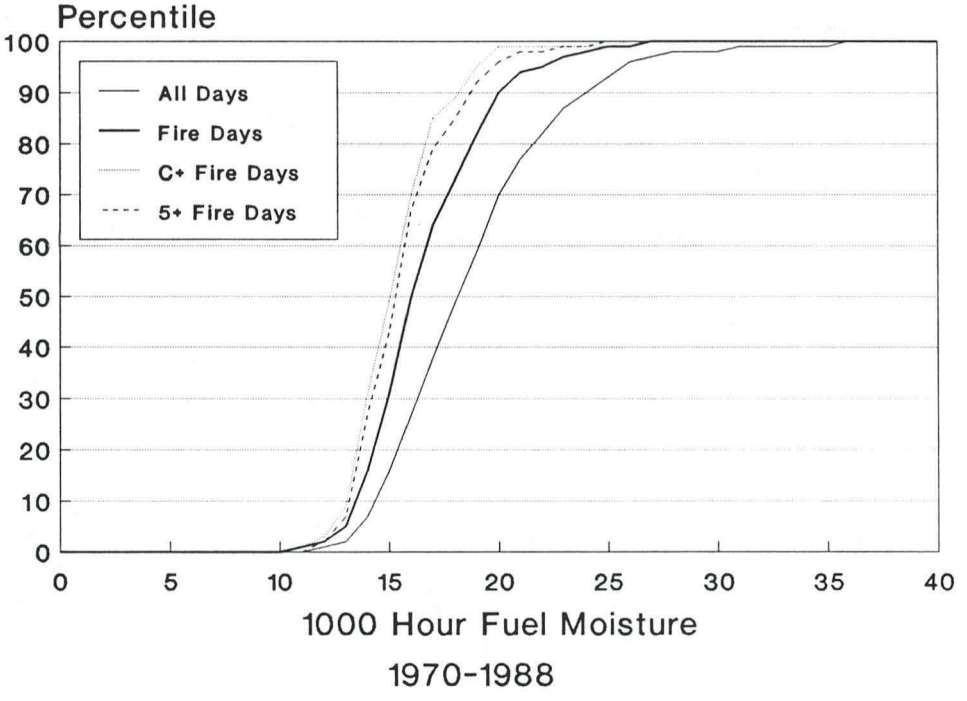

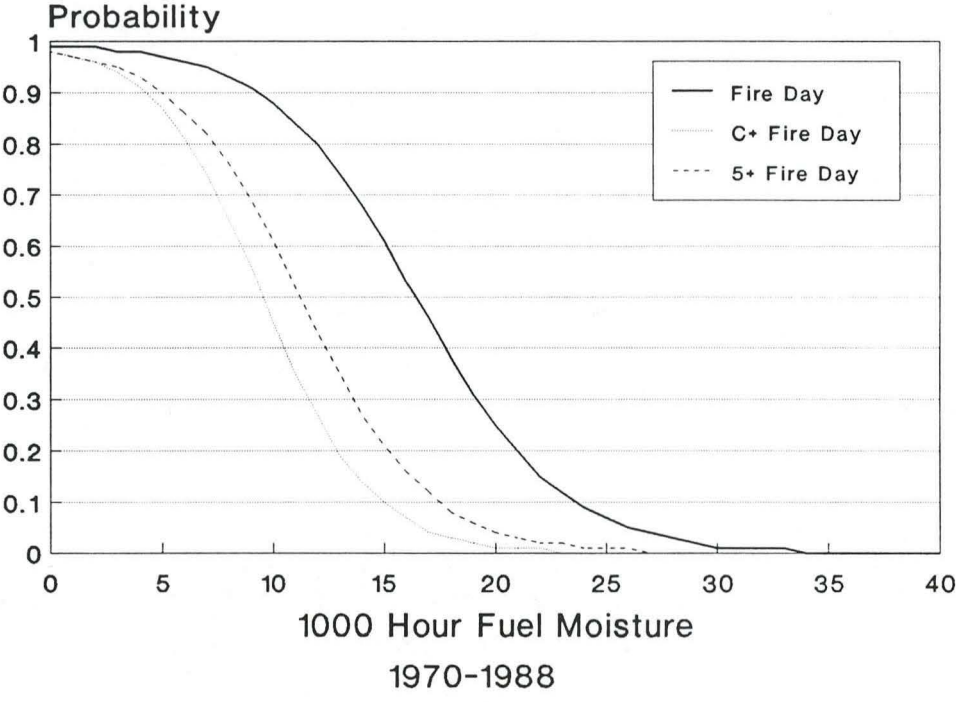

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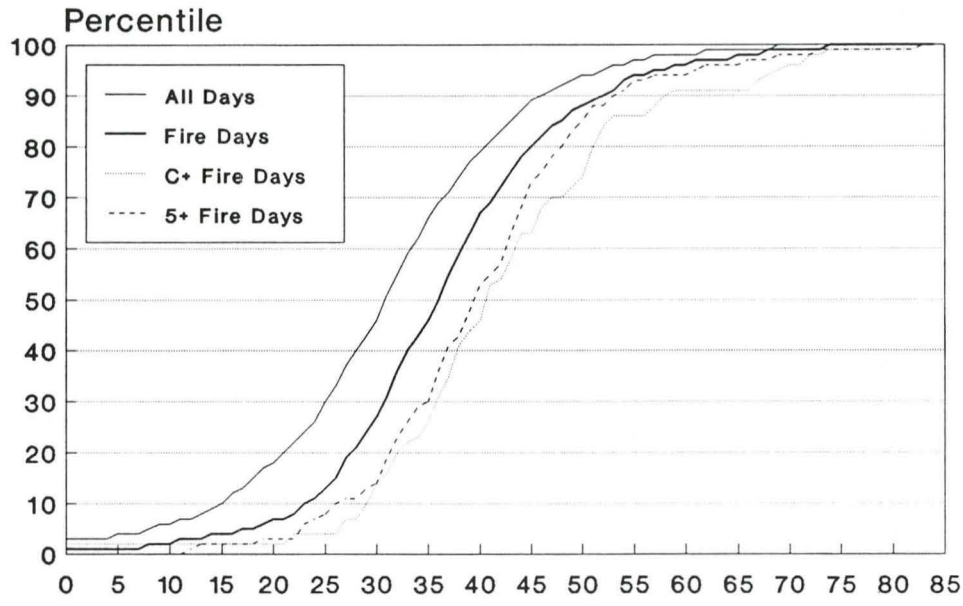

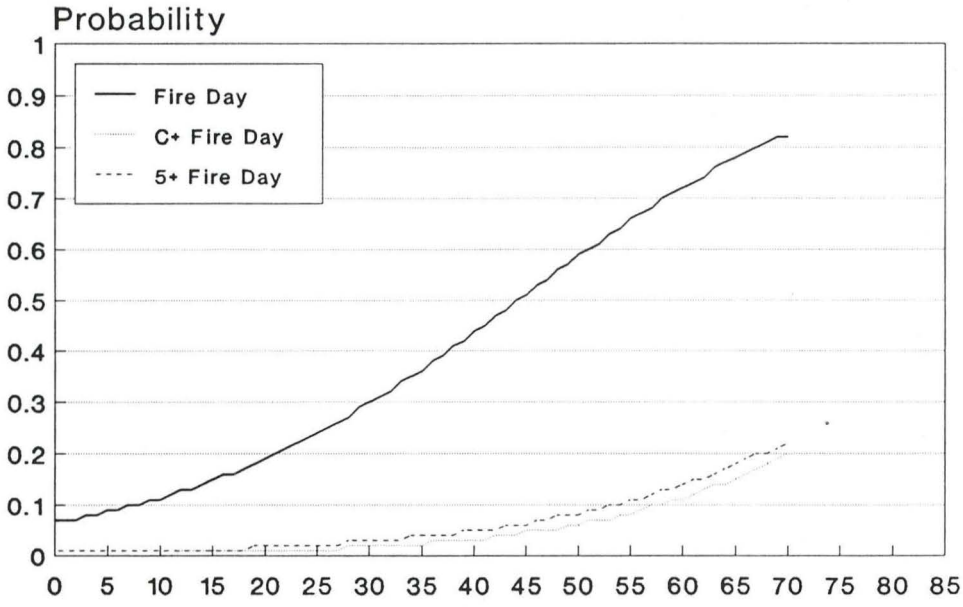

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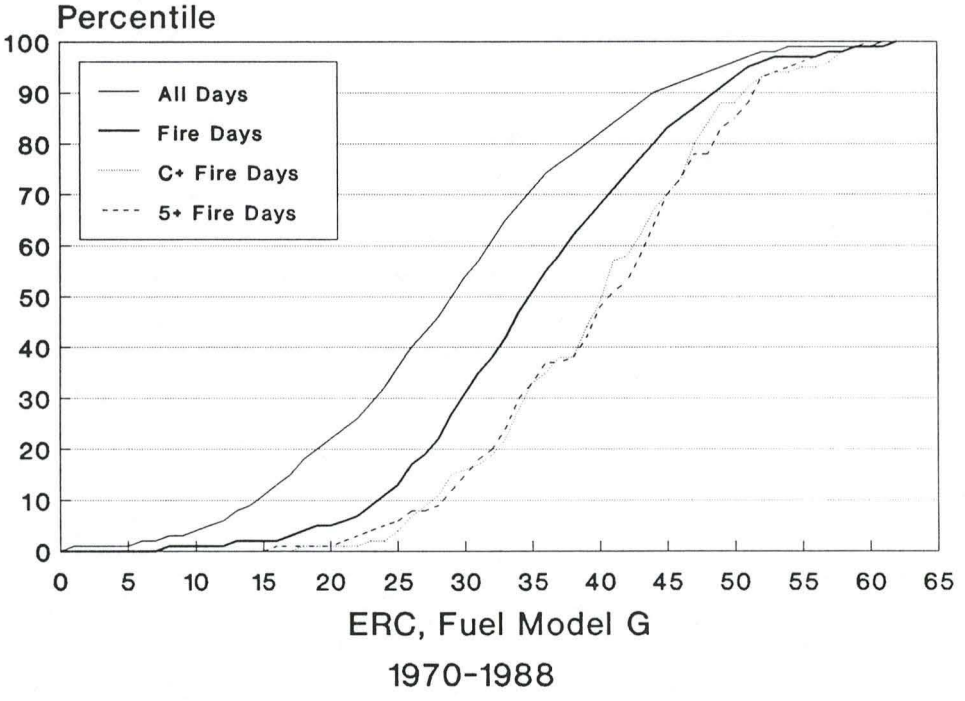

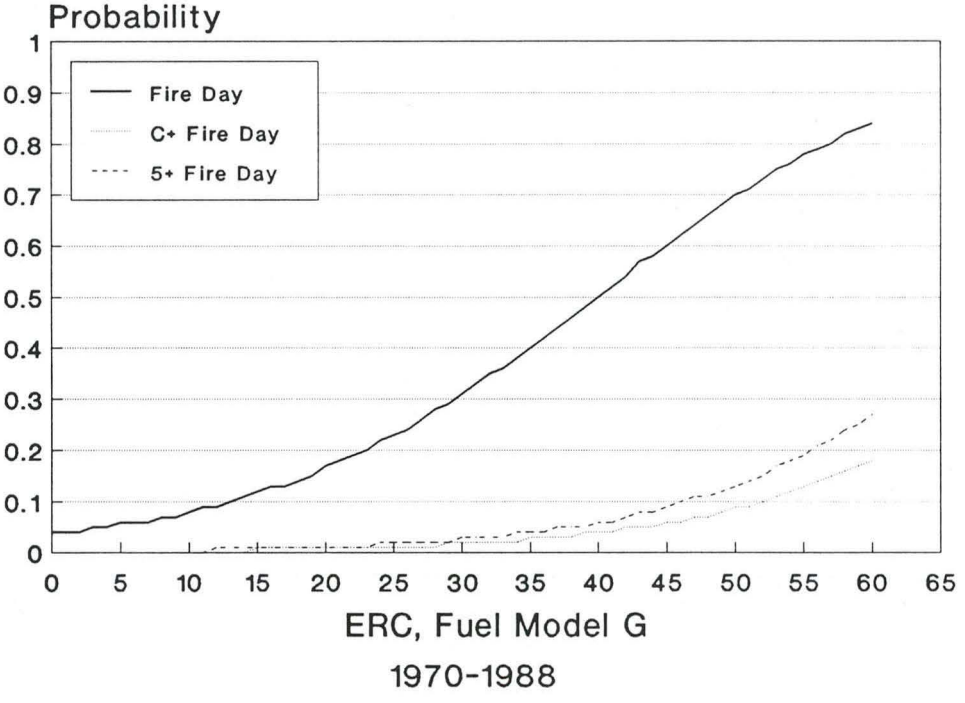

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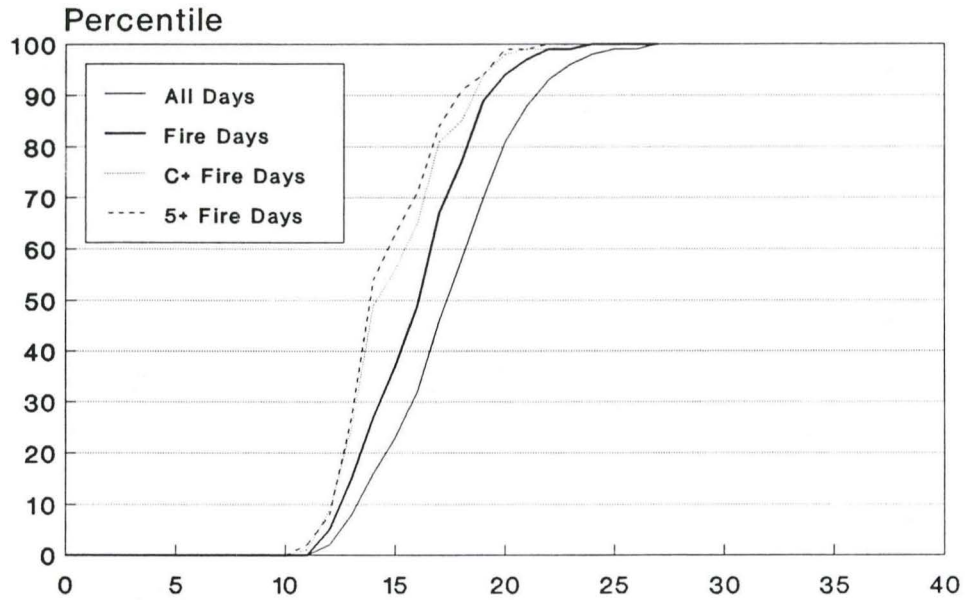
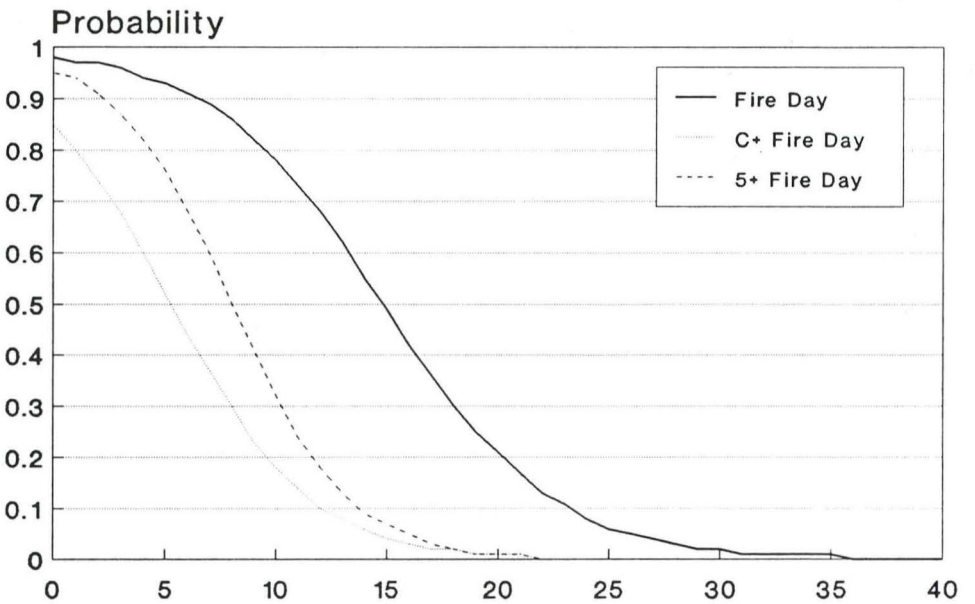


1970-1988



1970-1988

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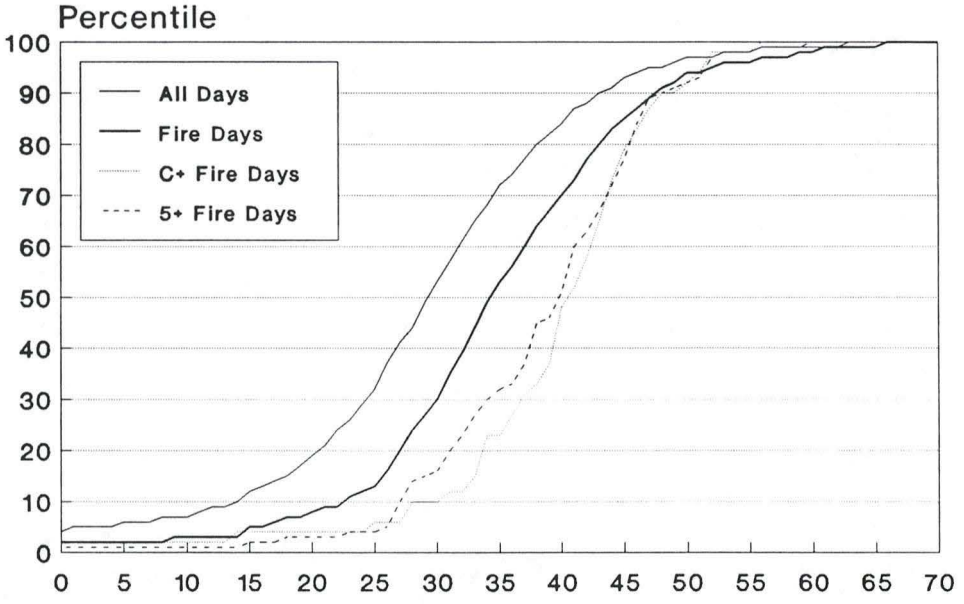

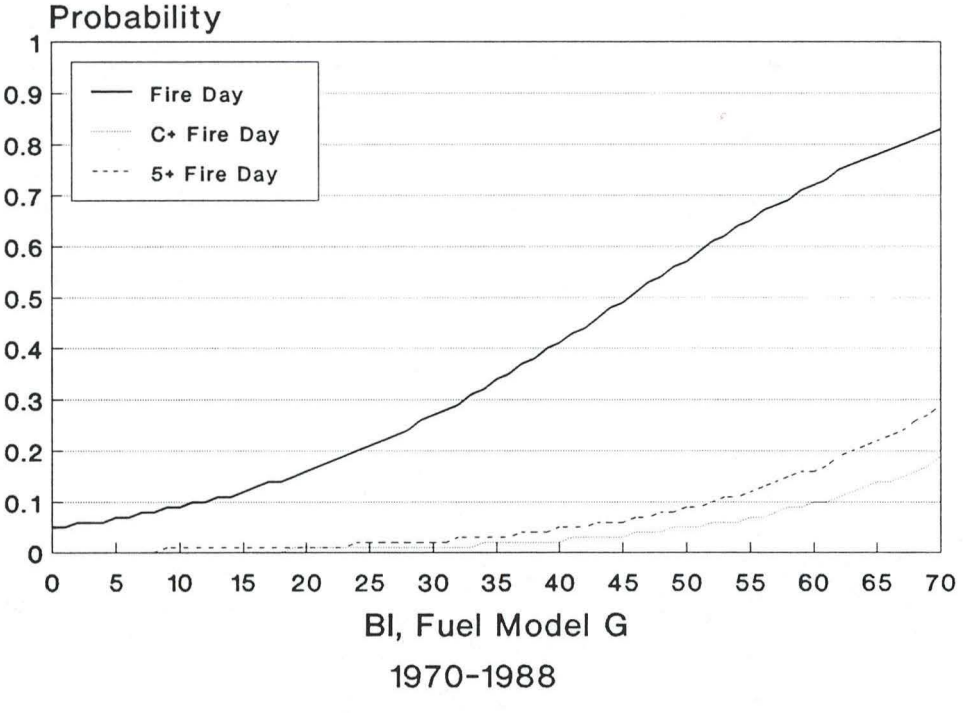

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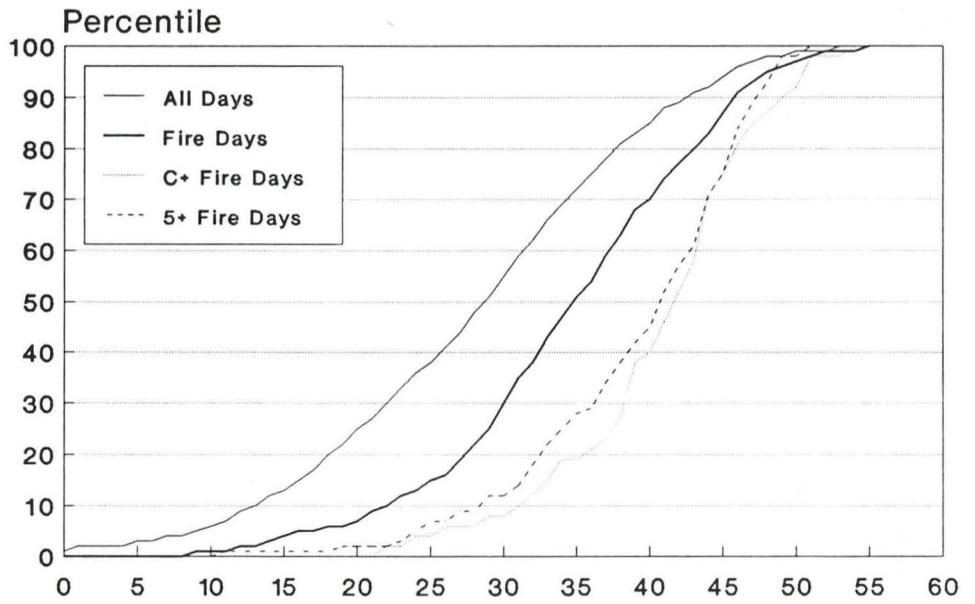

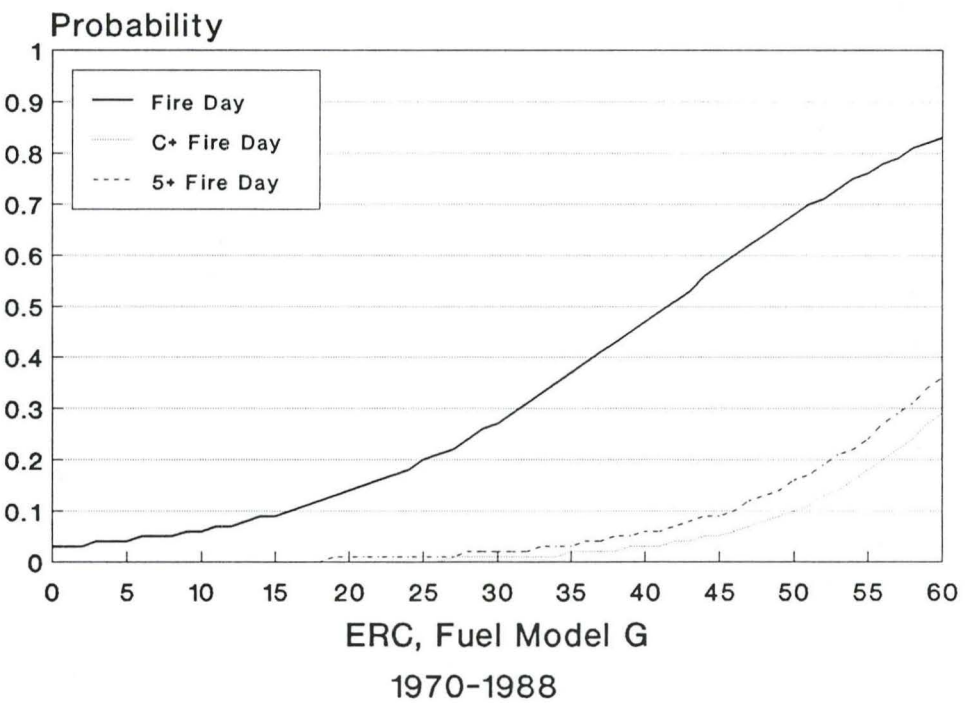

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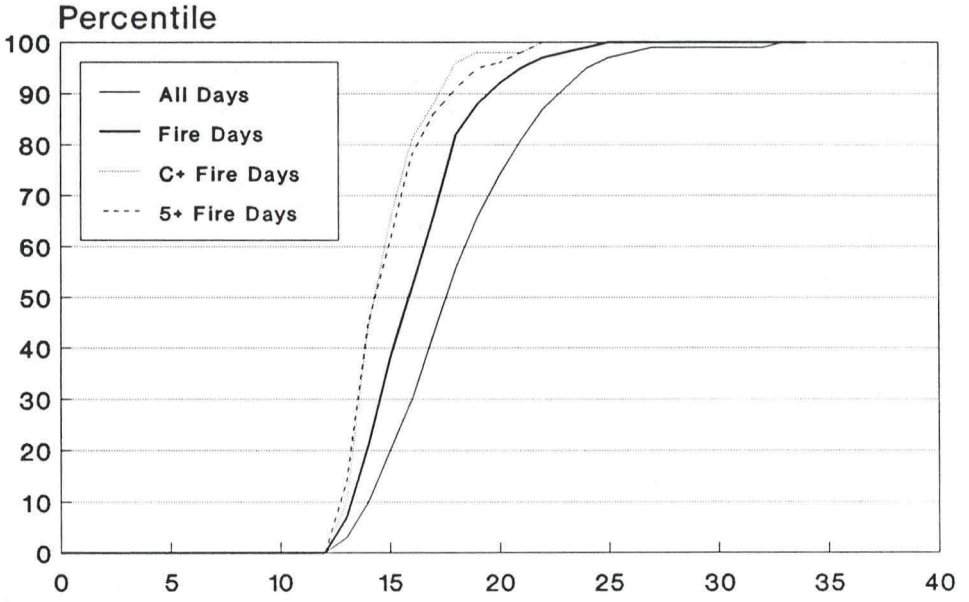

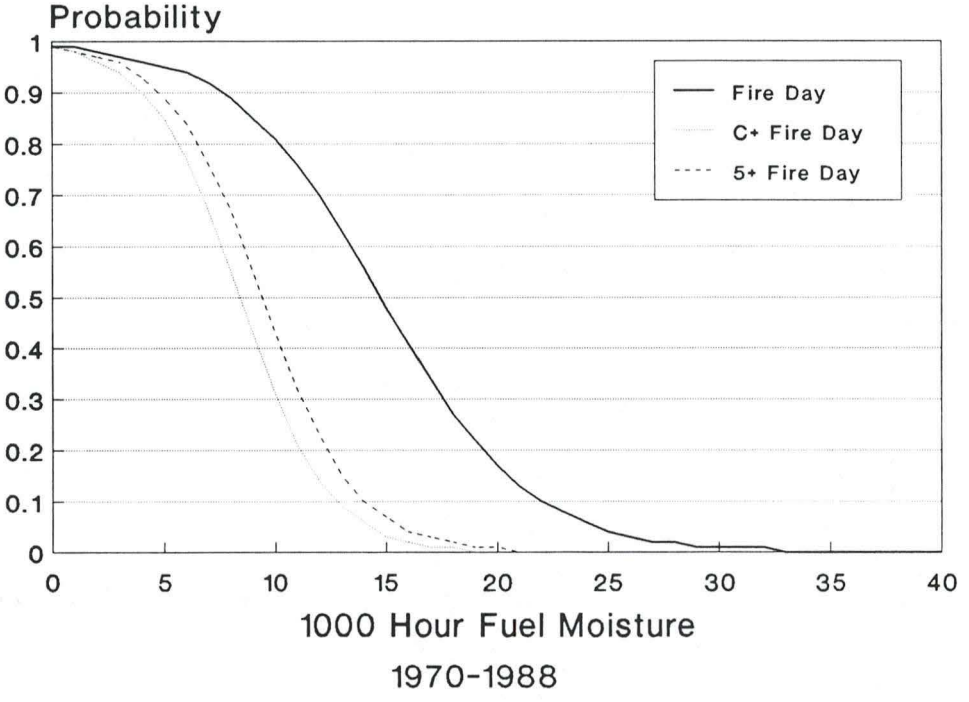

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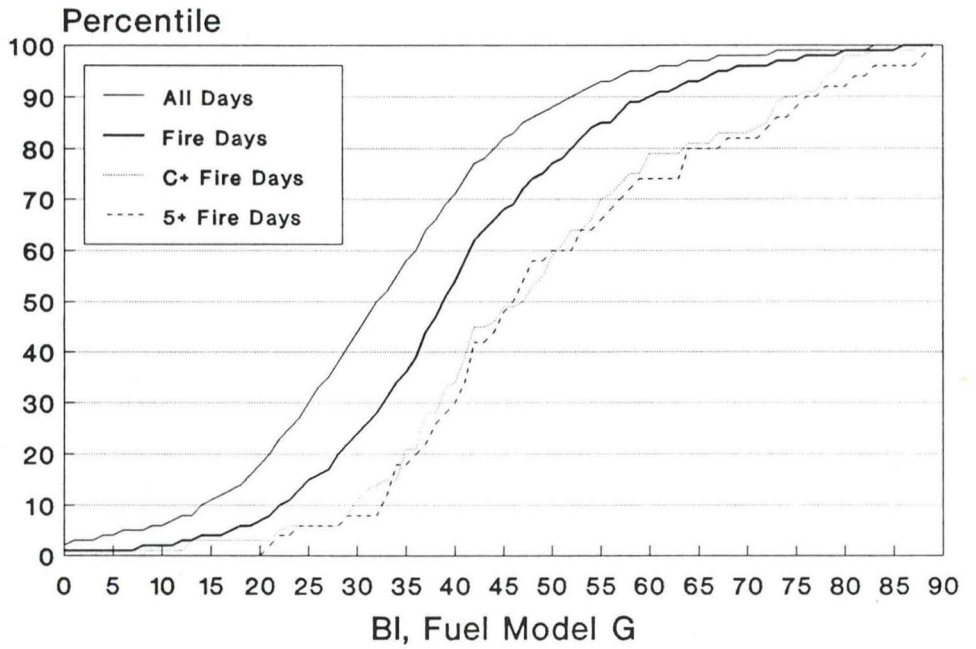

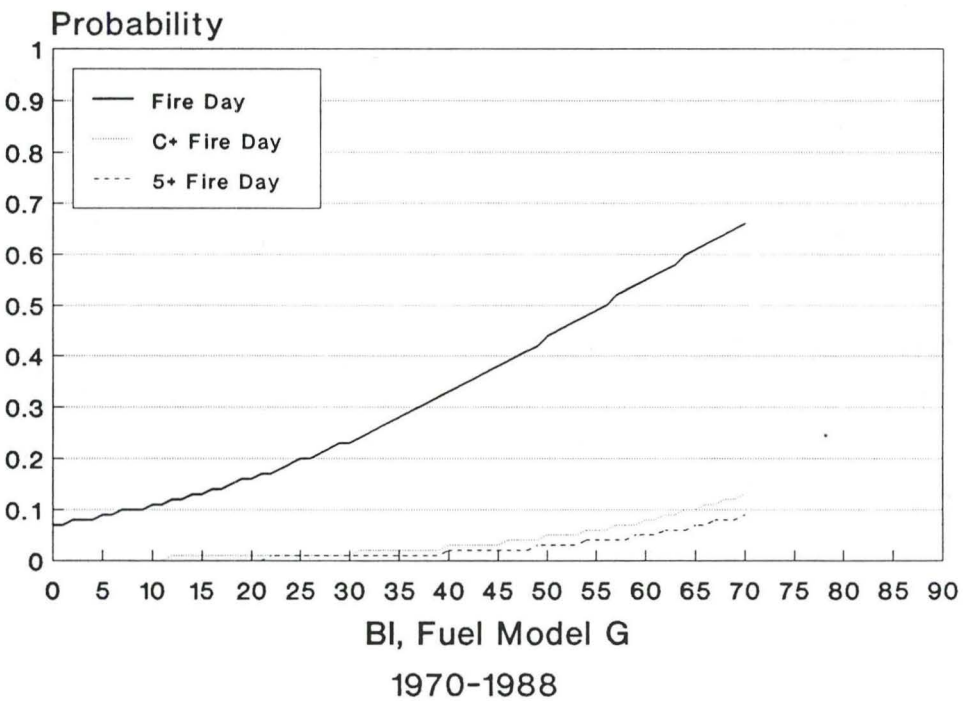

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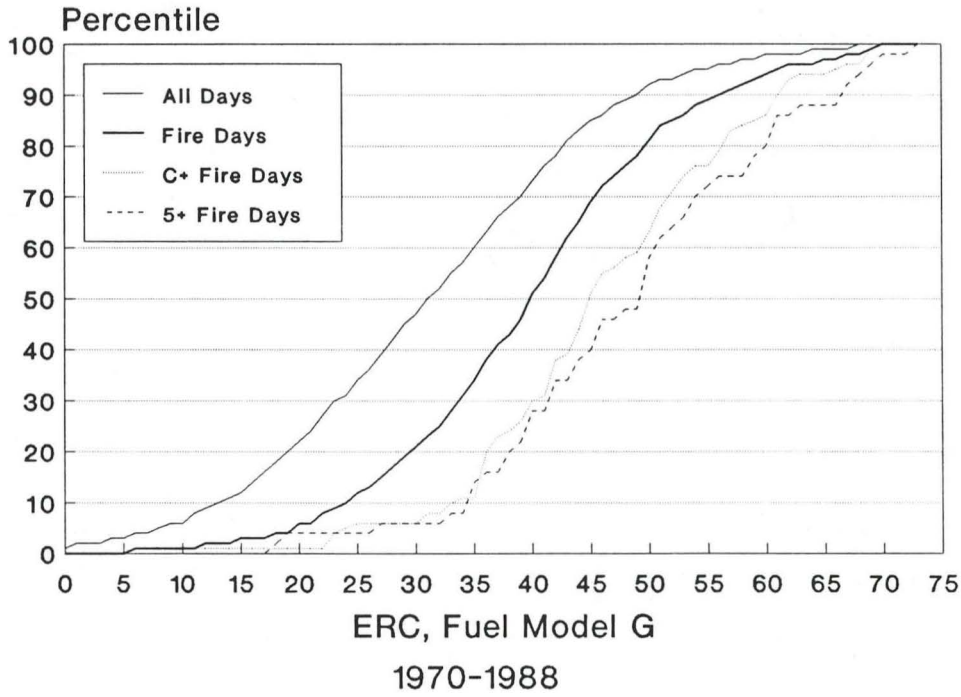

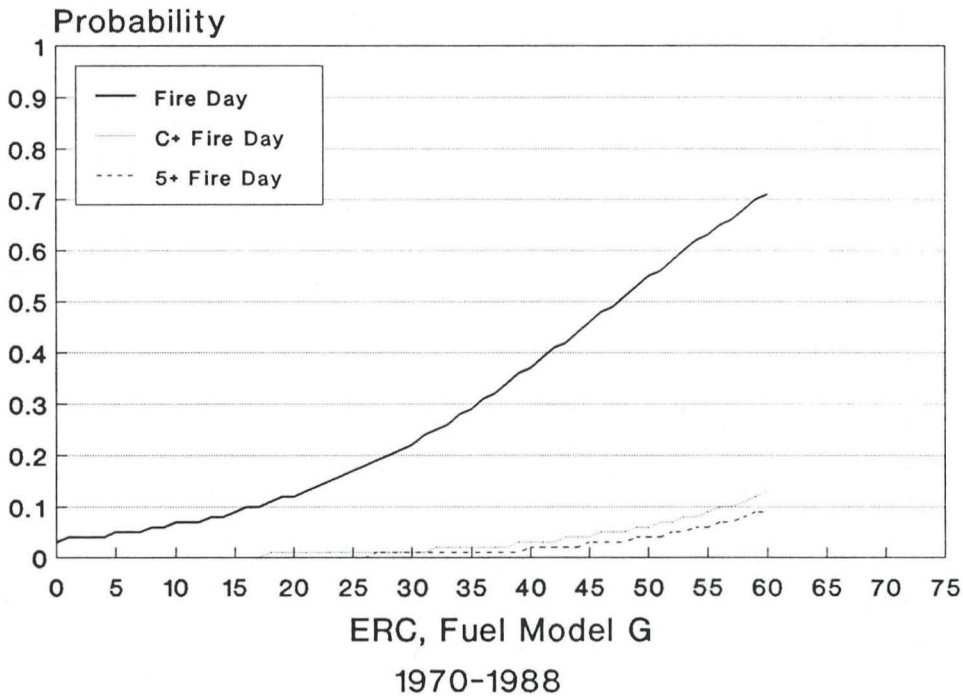

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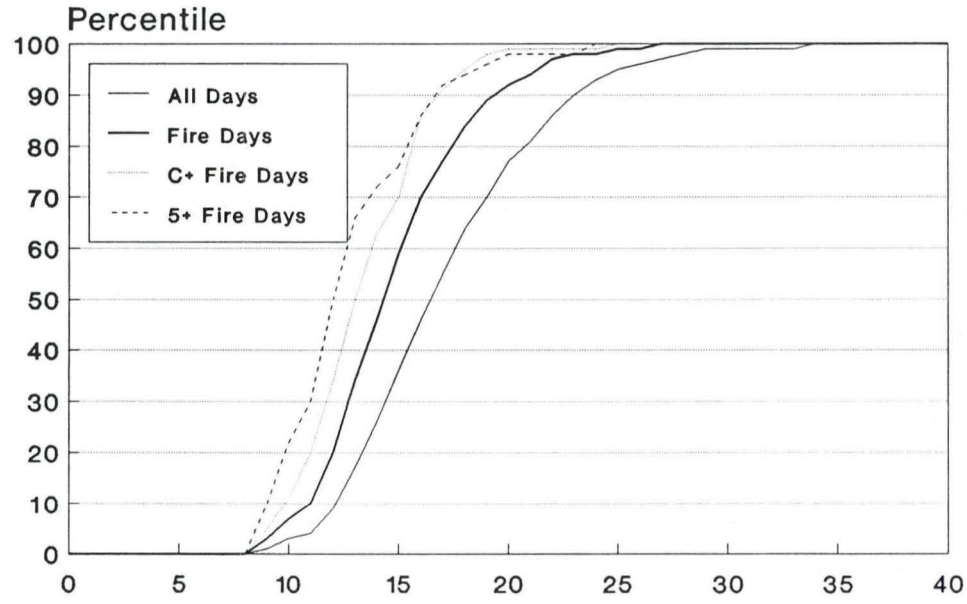

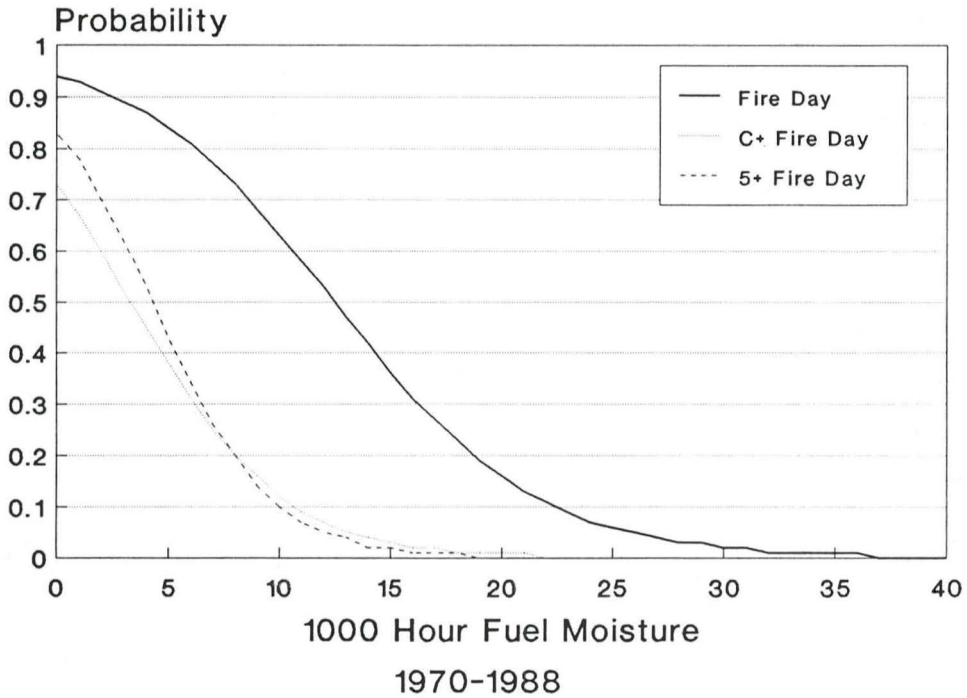

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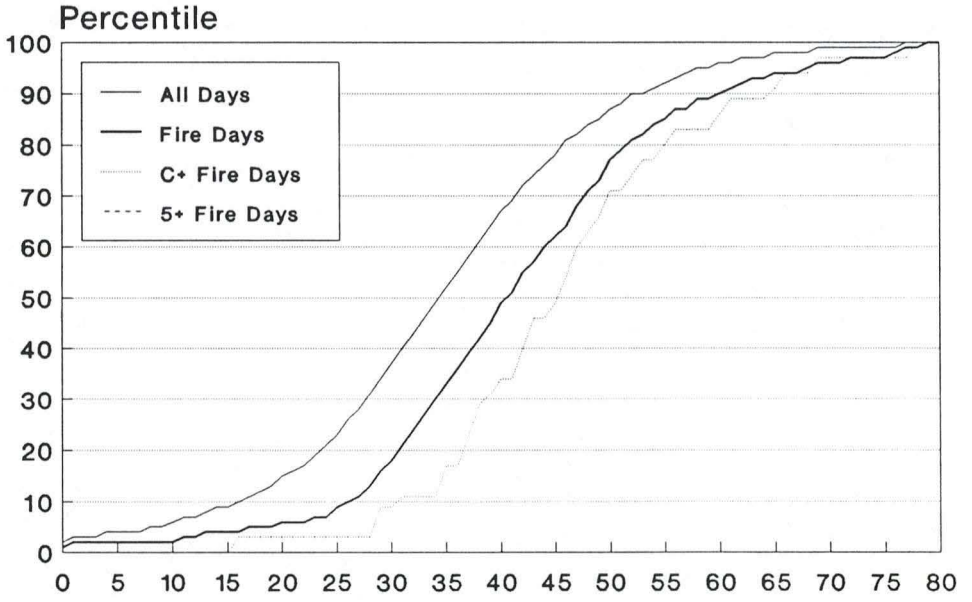

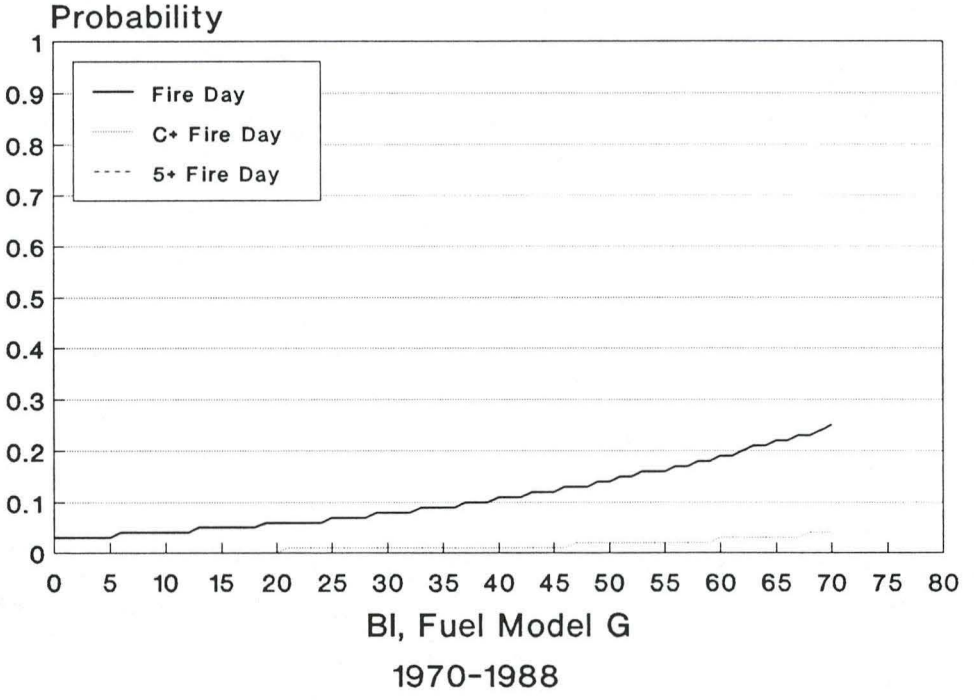

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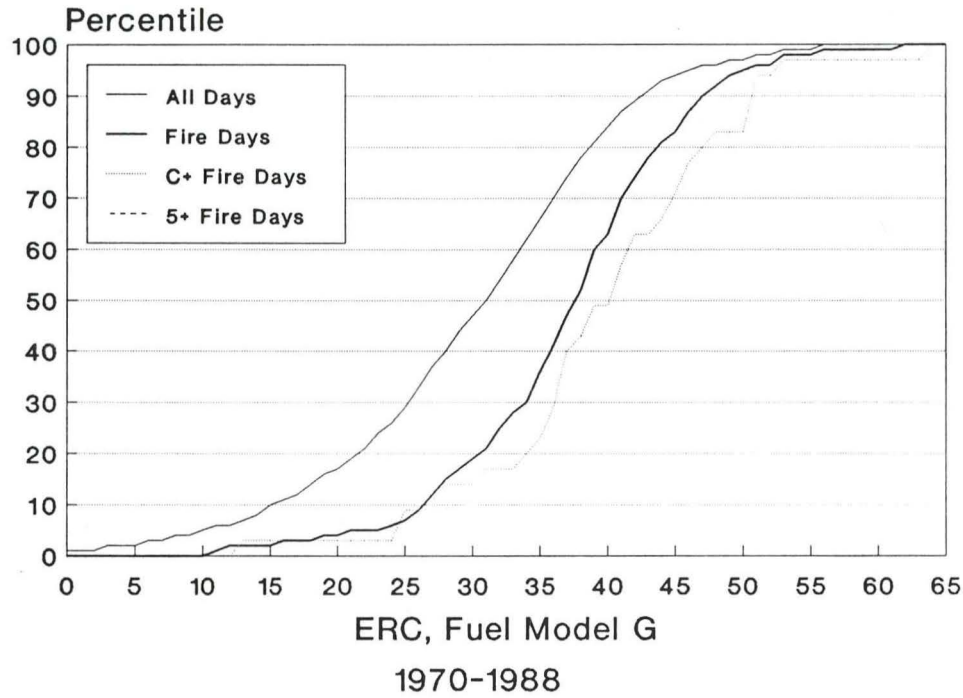

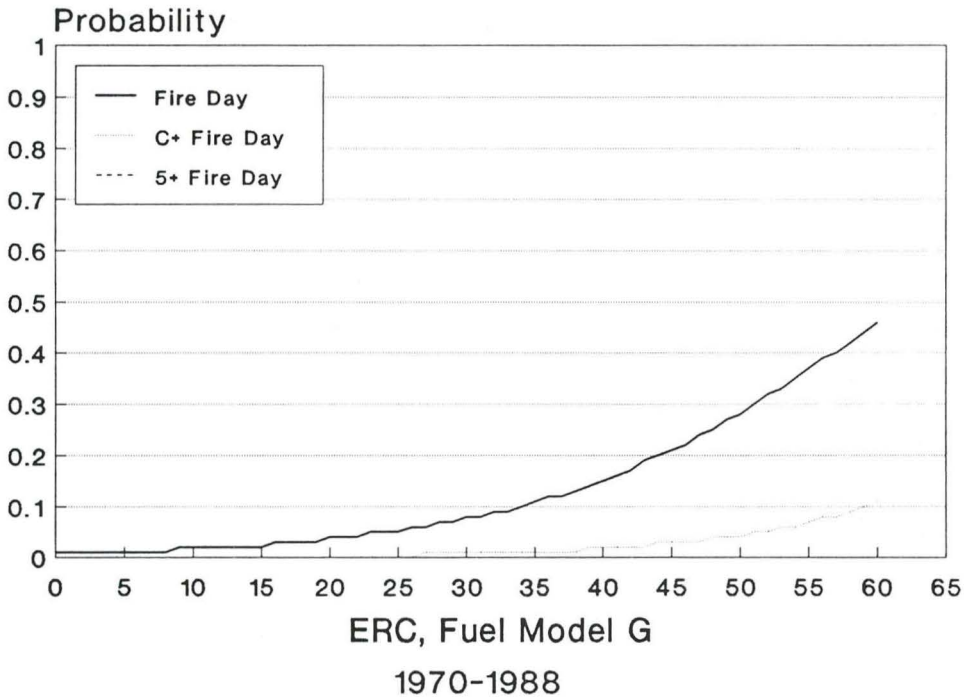

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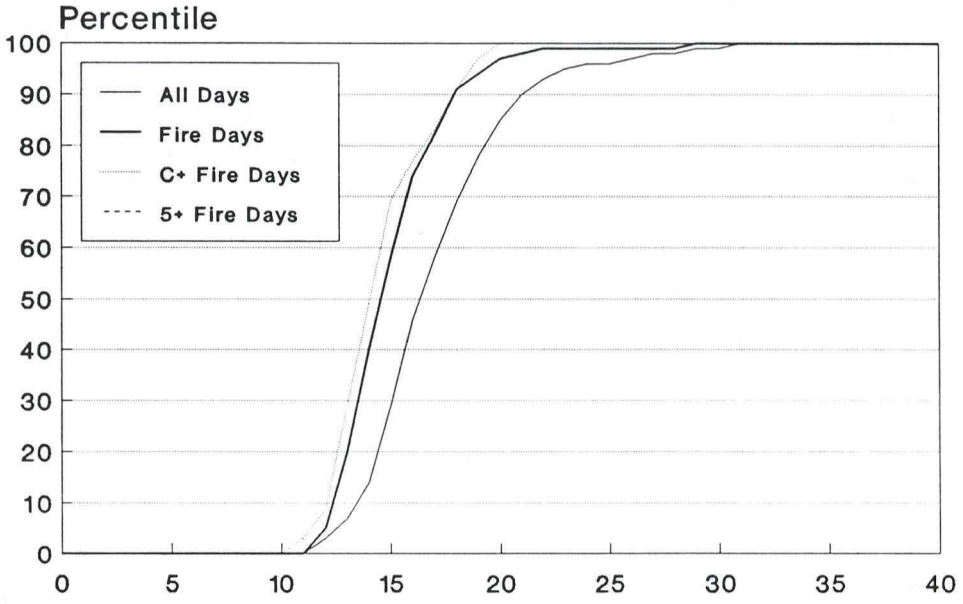

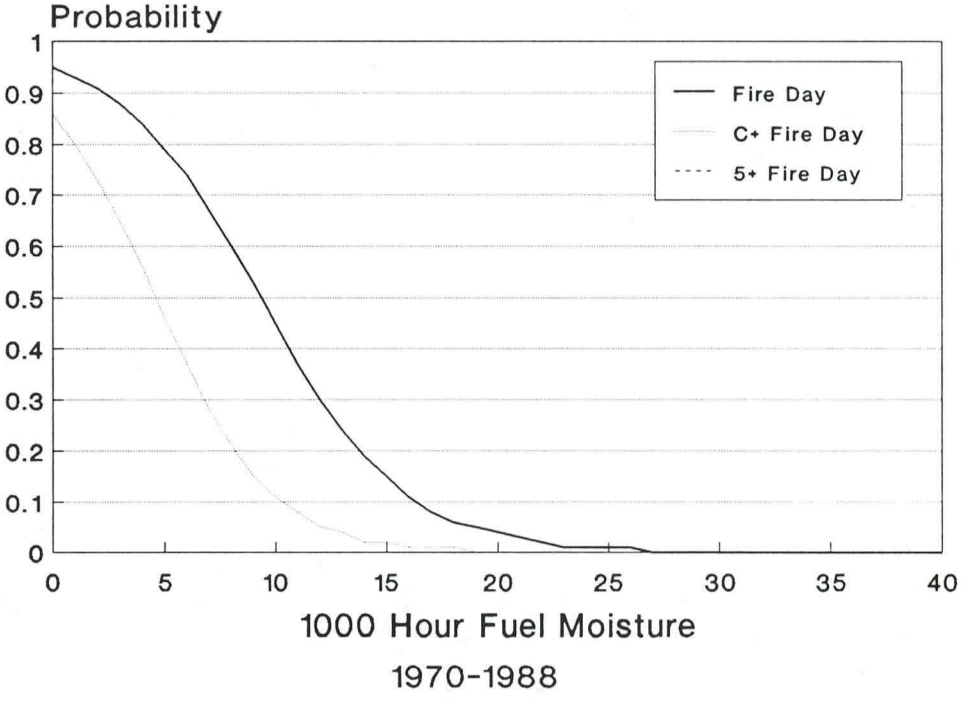

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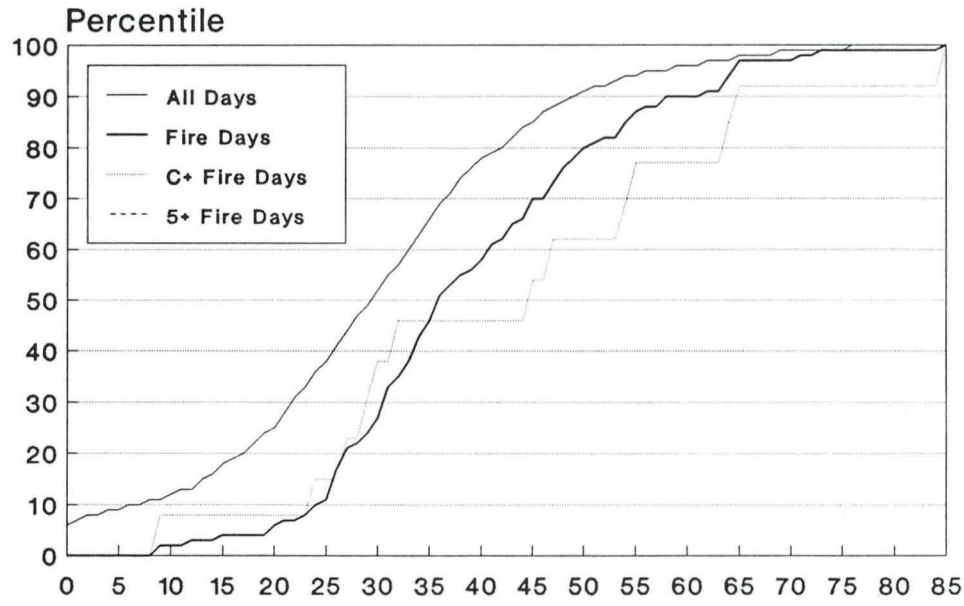

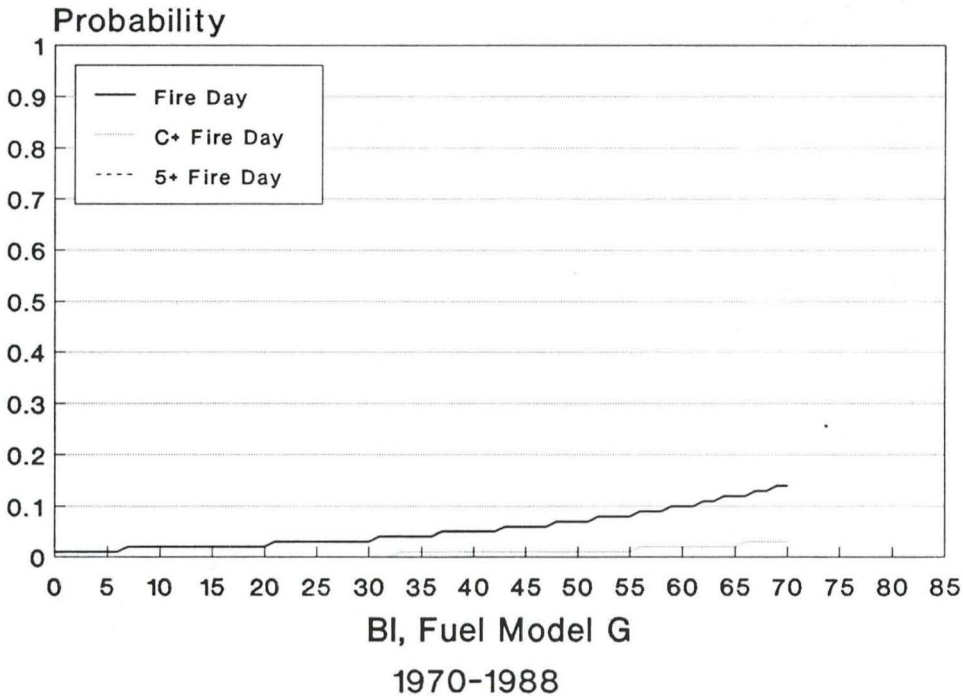

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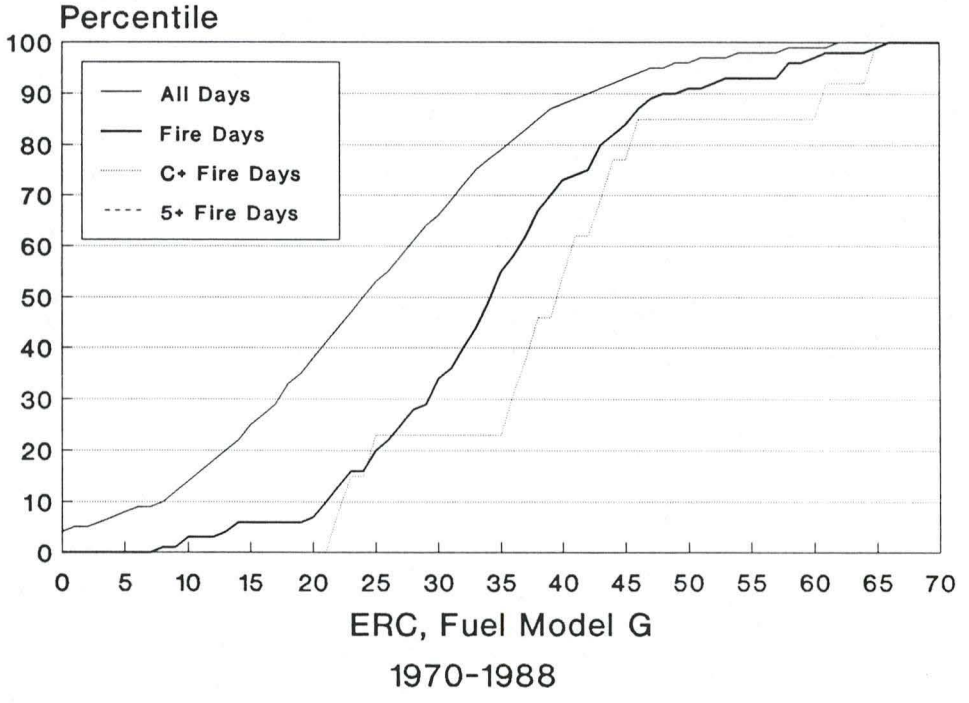

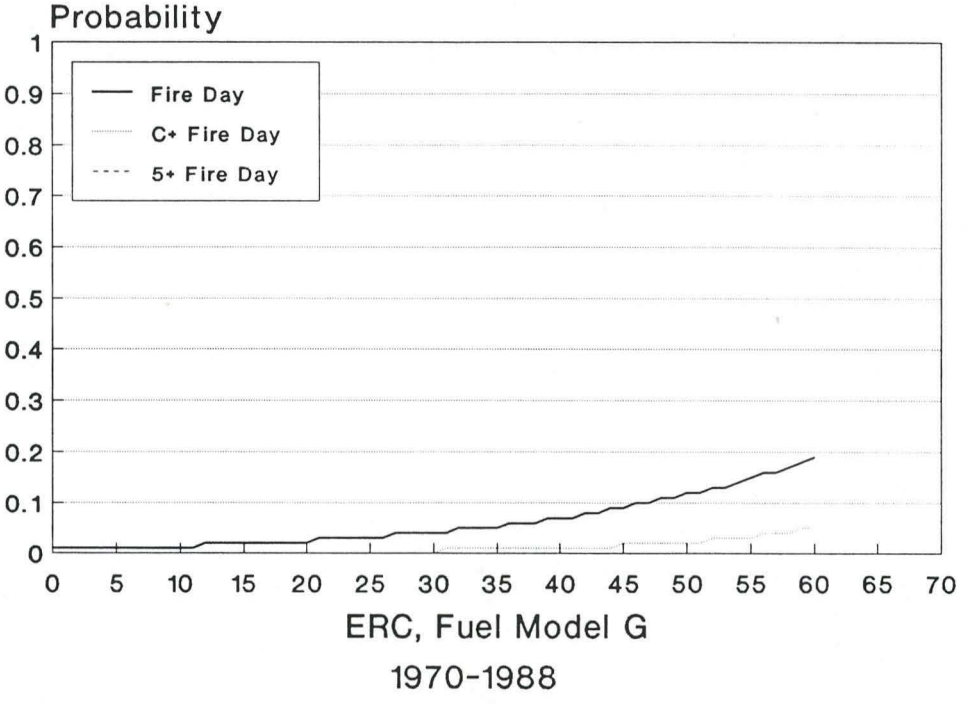

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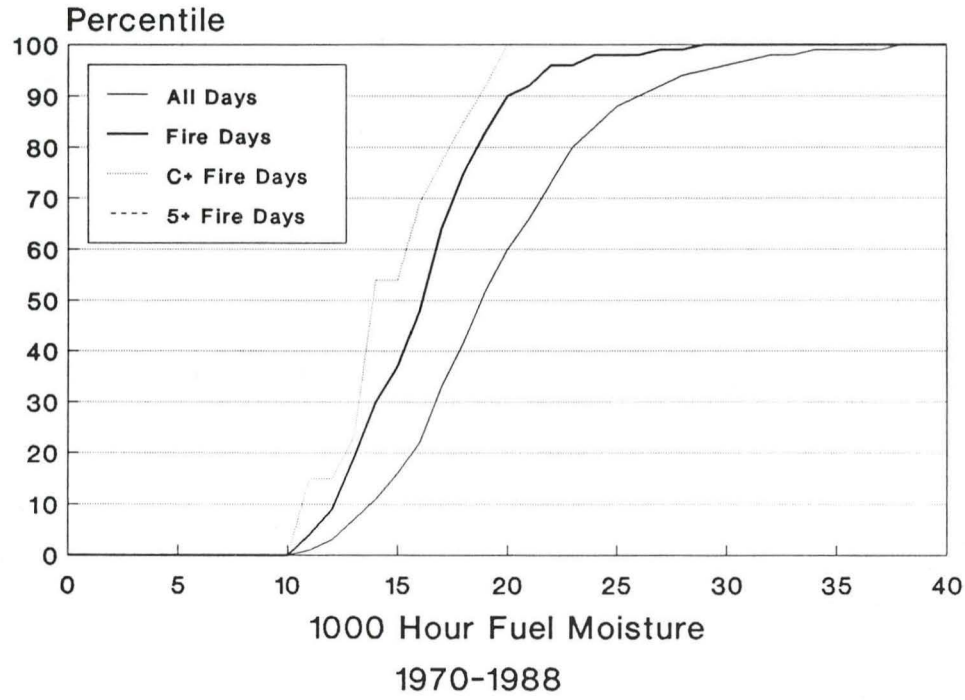

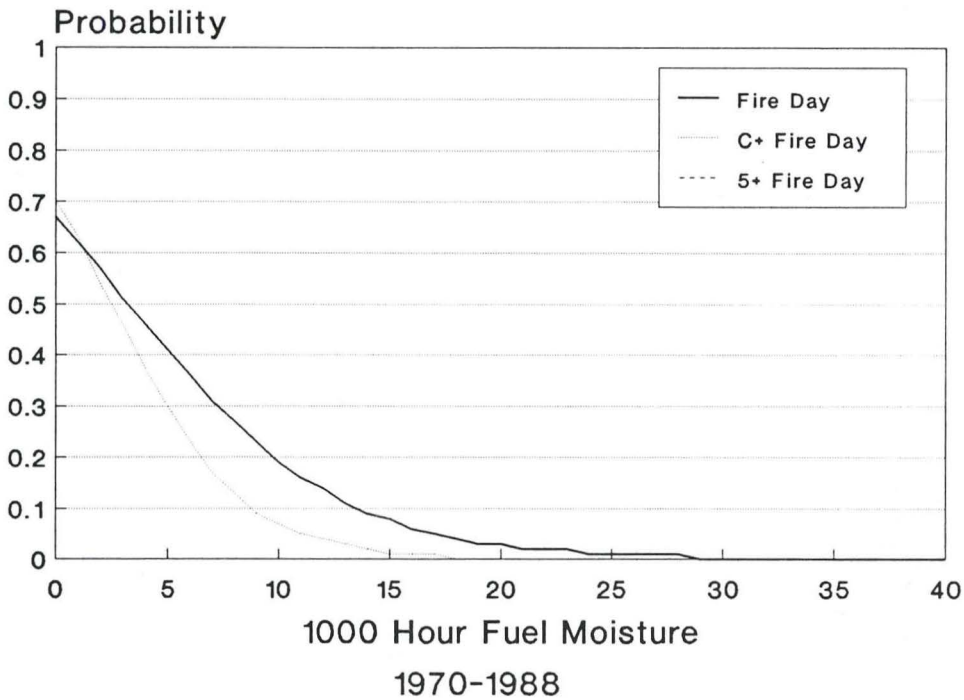

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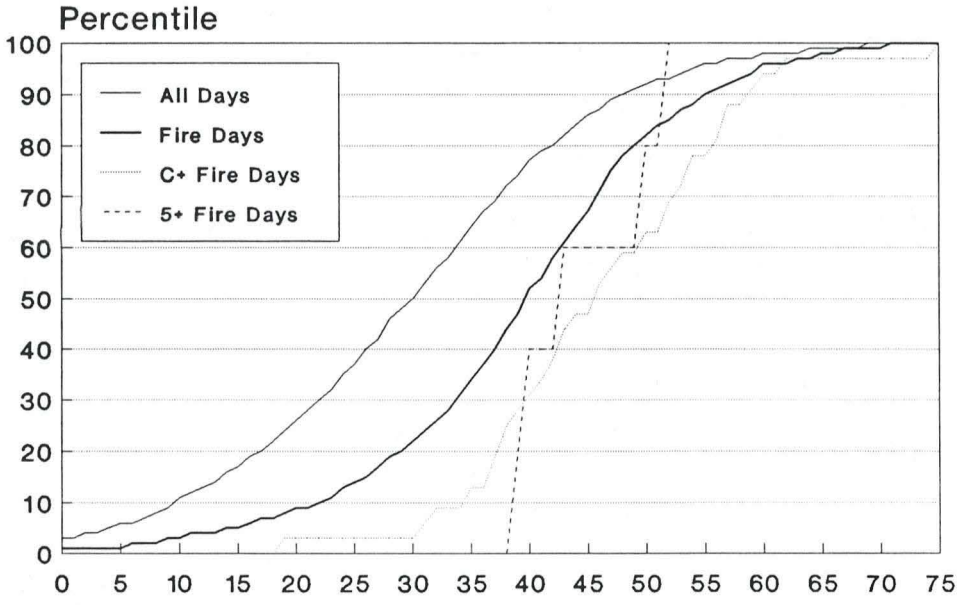

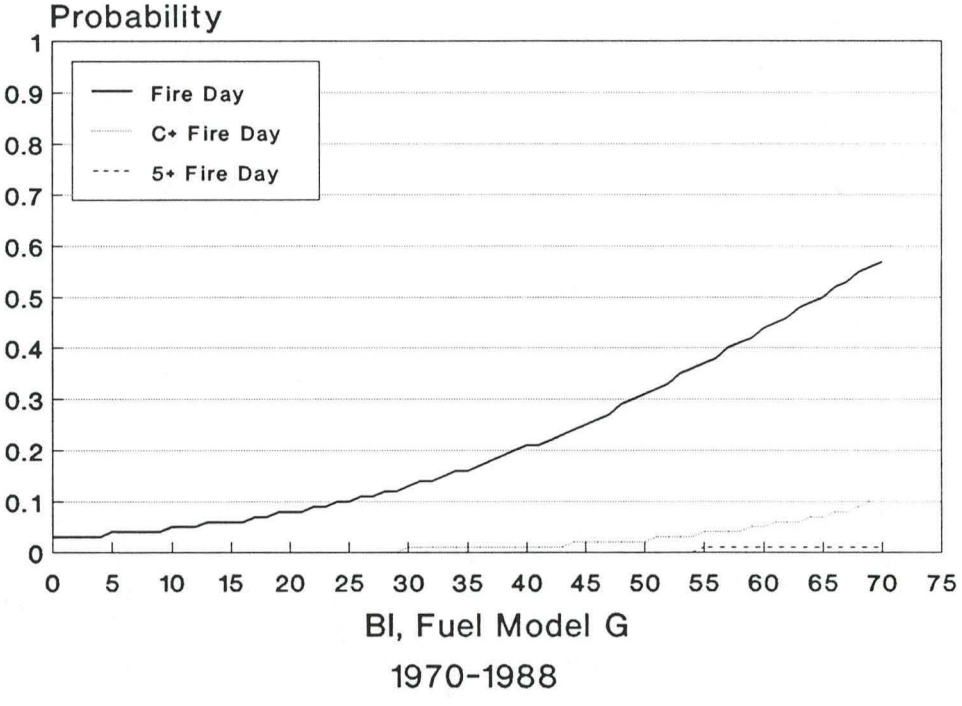

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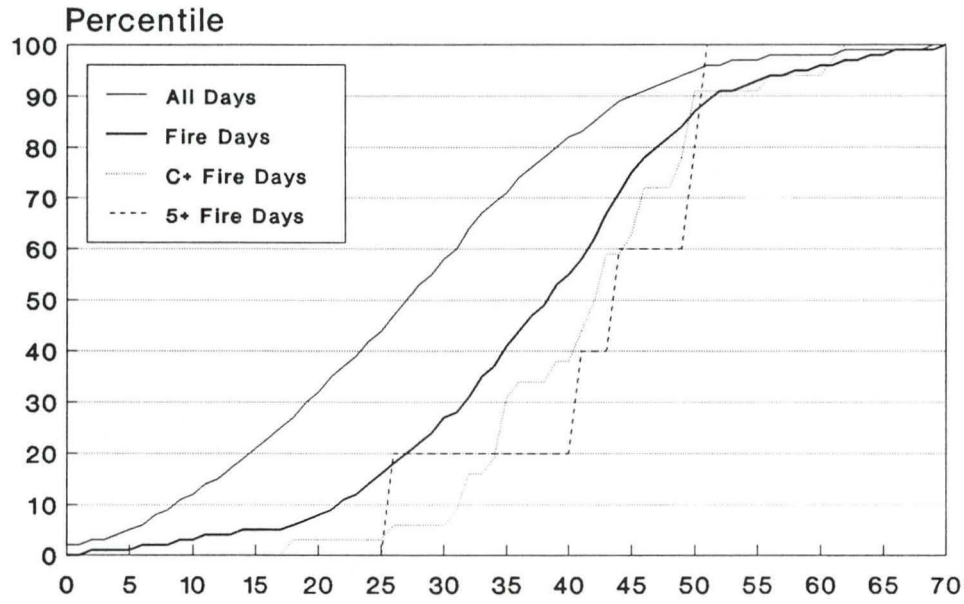

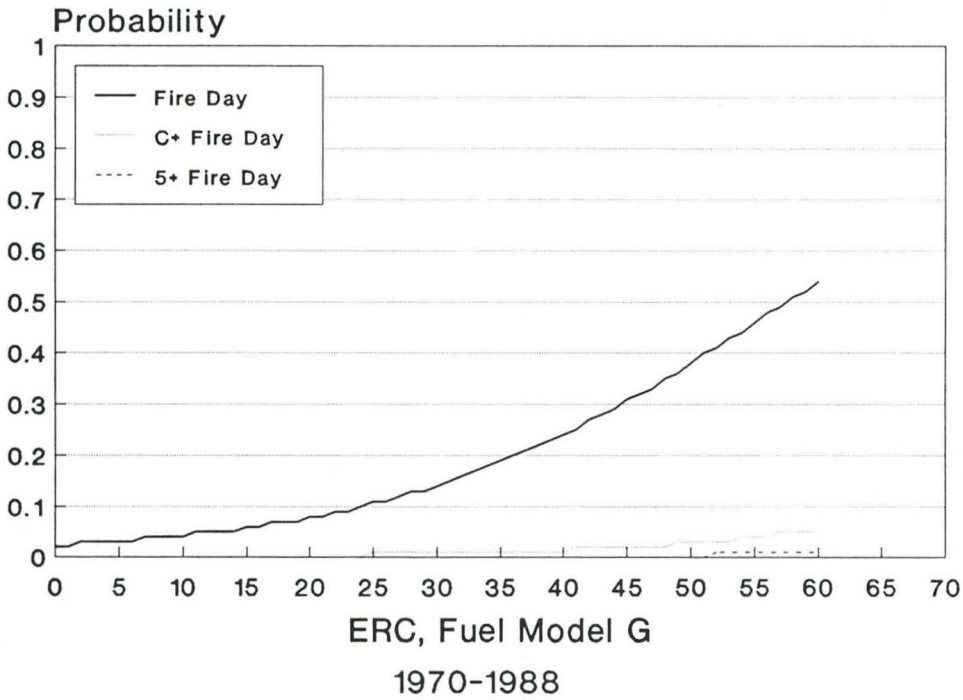

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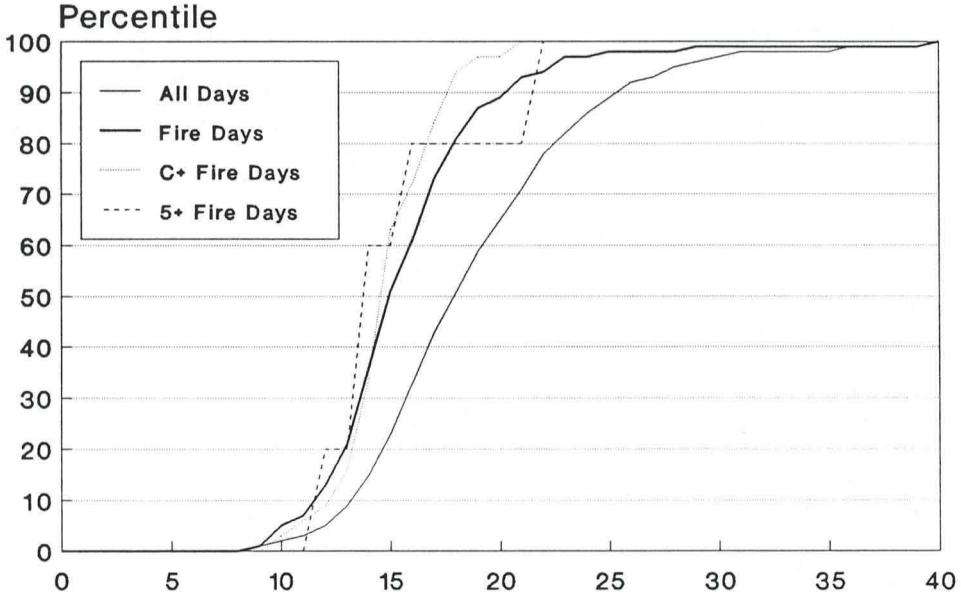

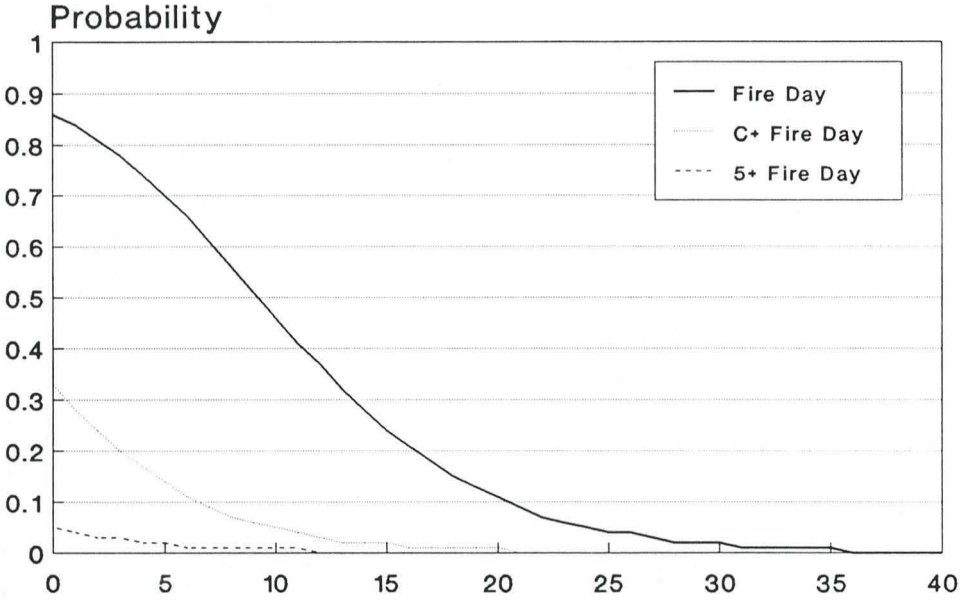

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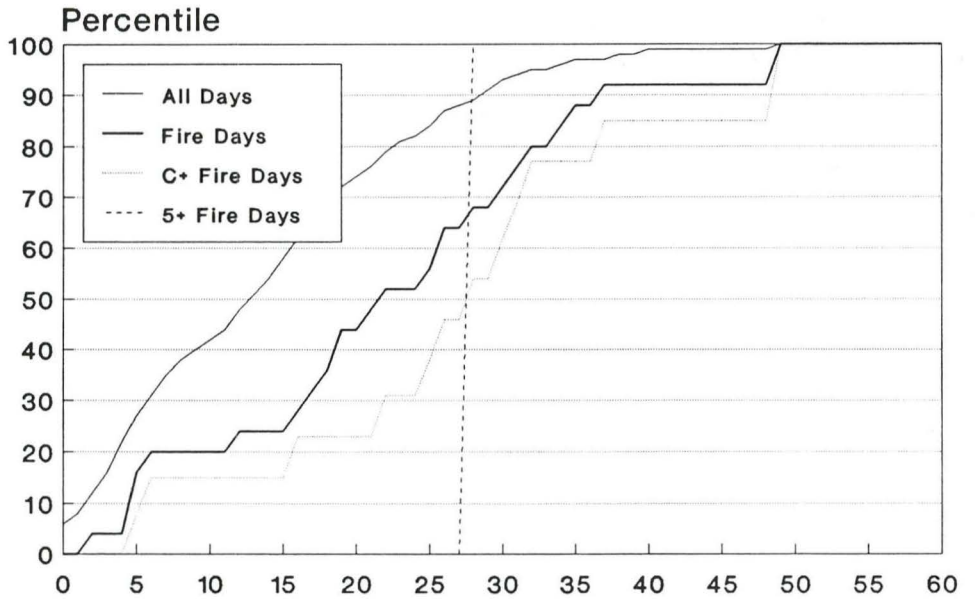

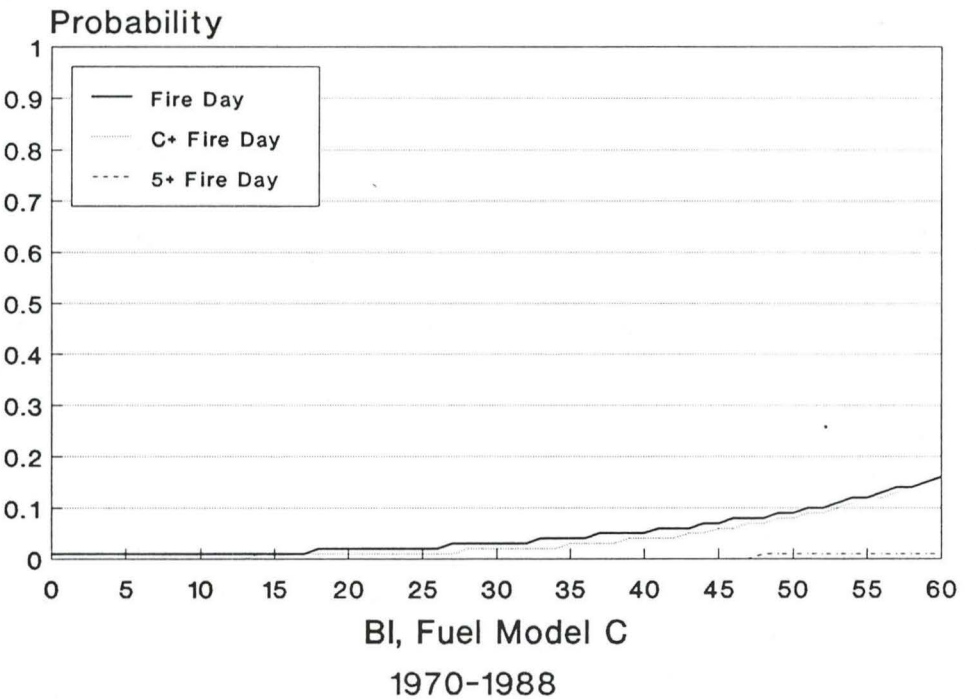

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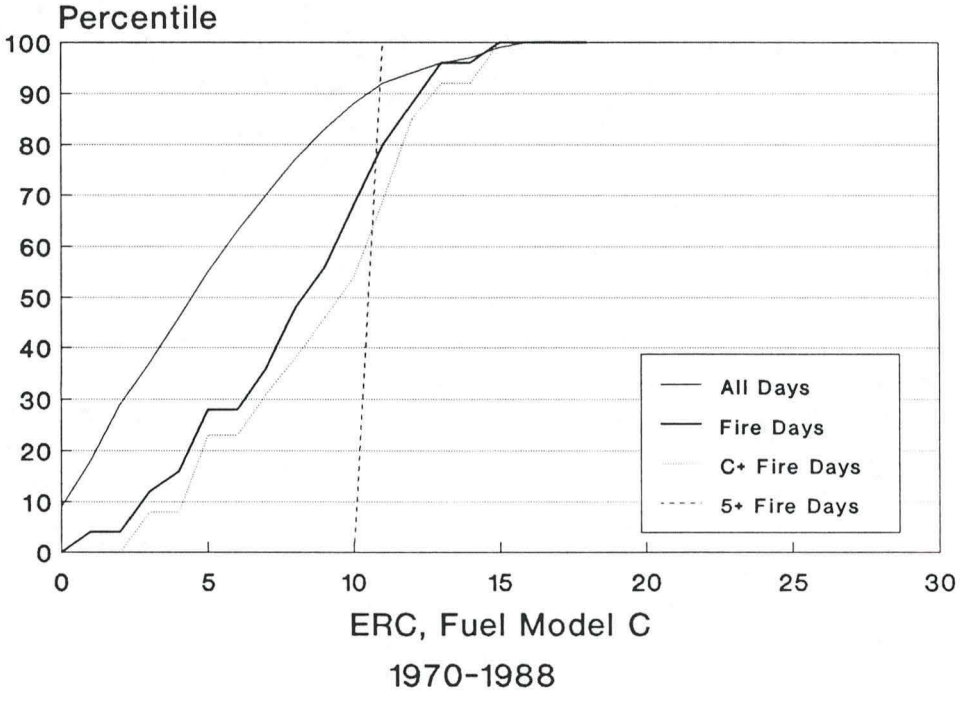

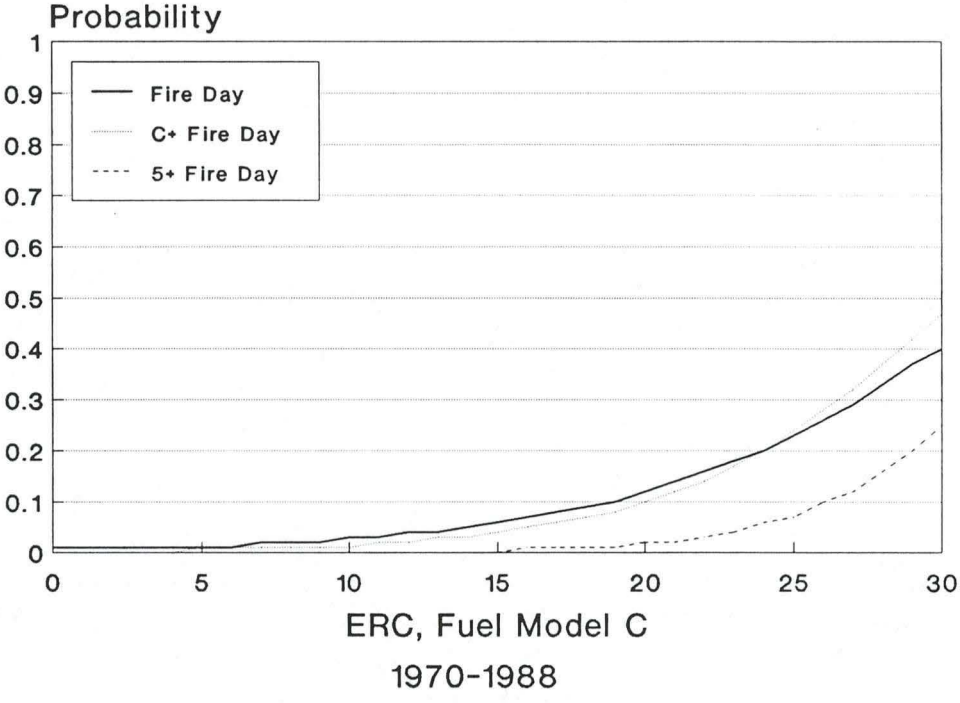

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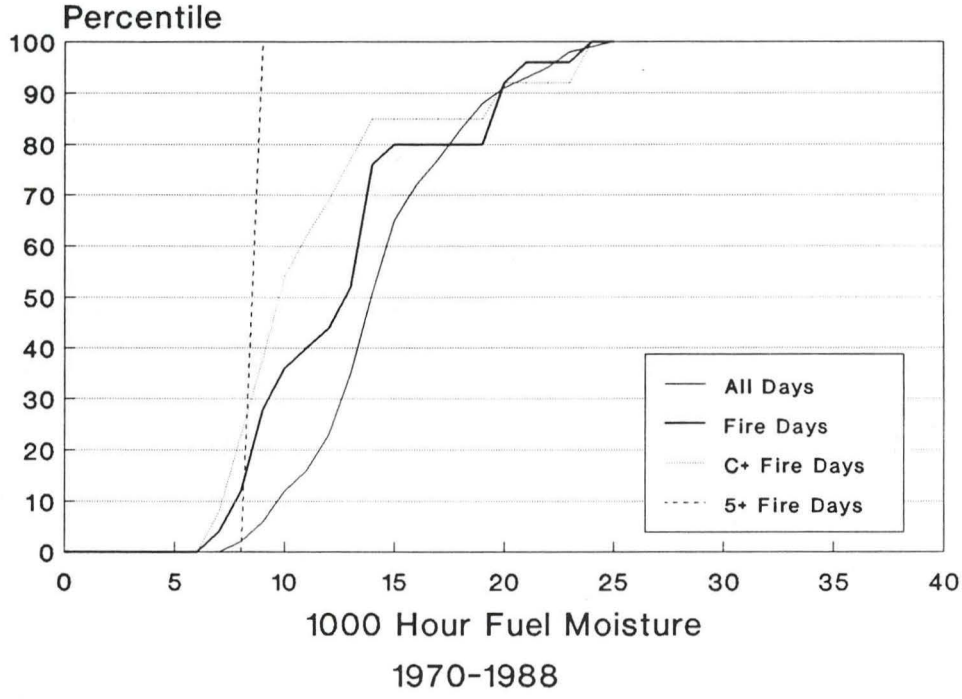

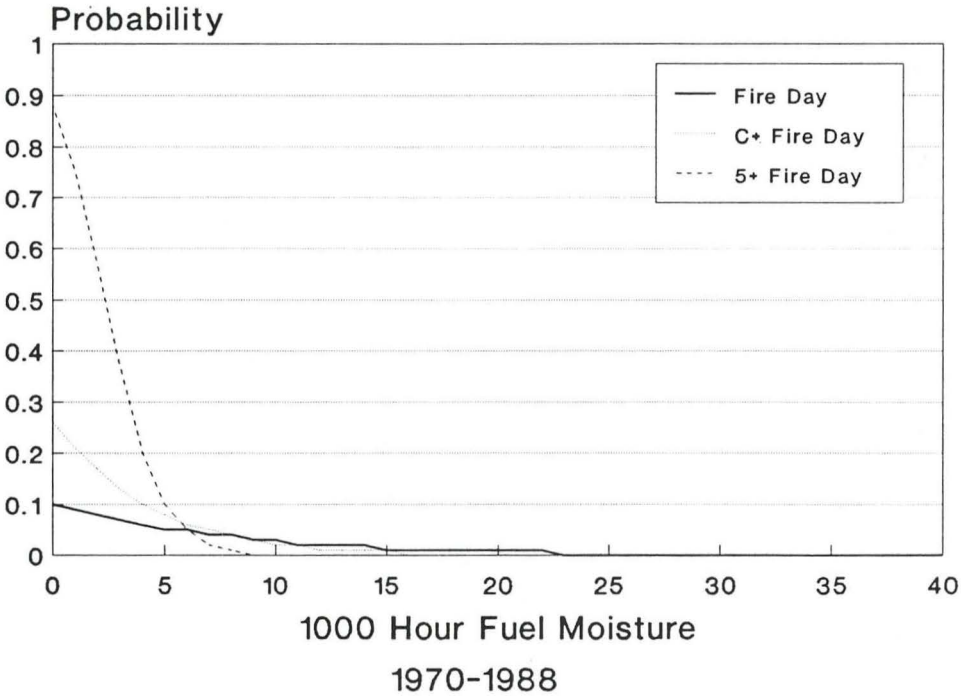

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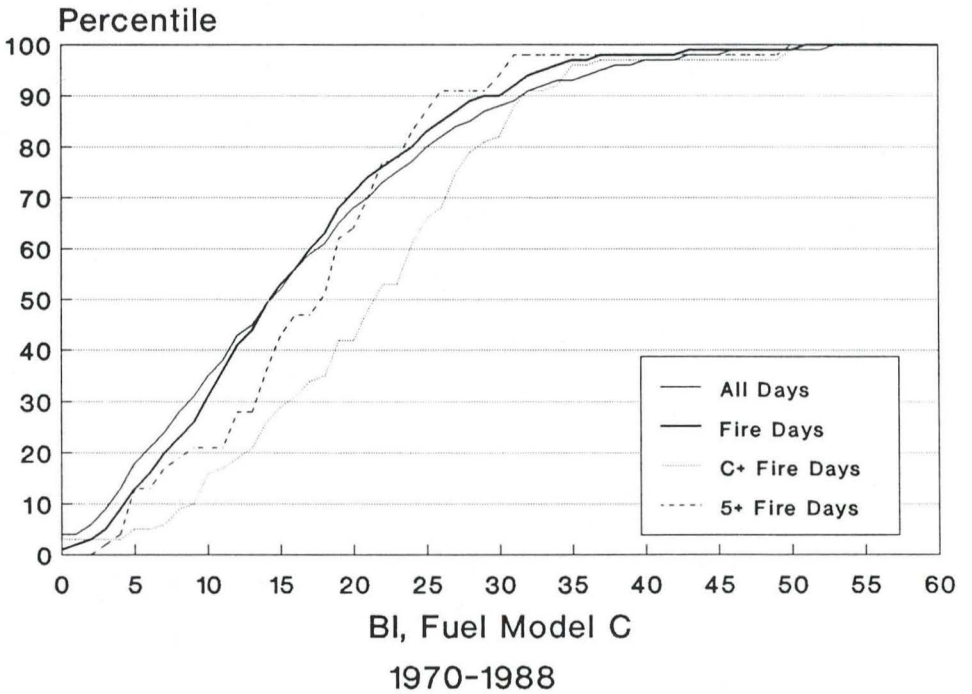

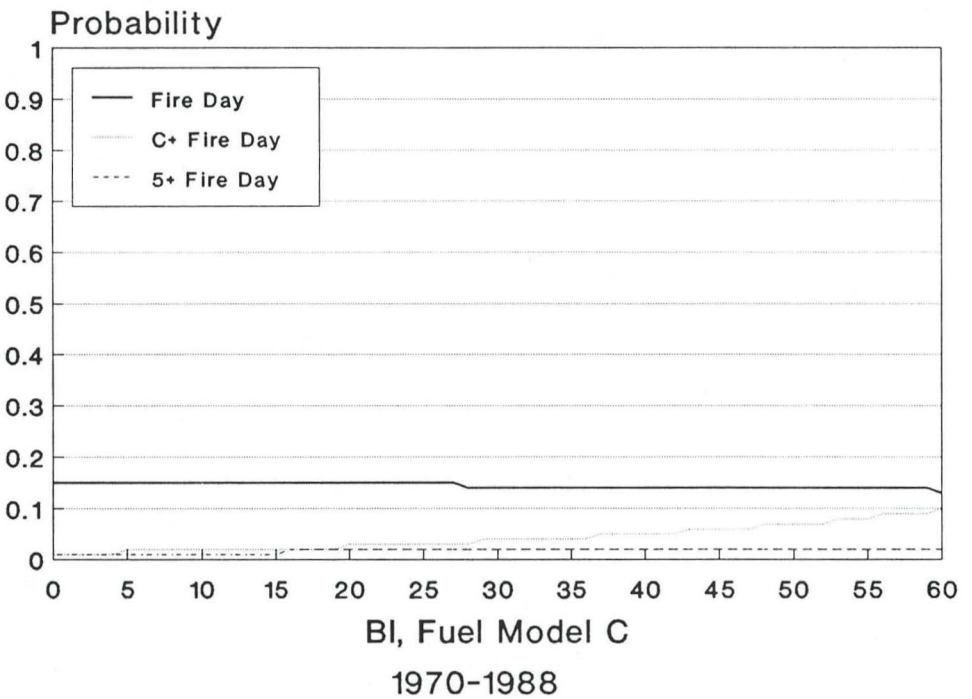

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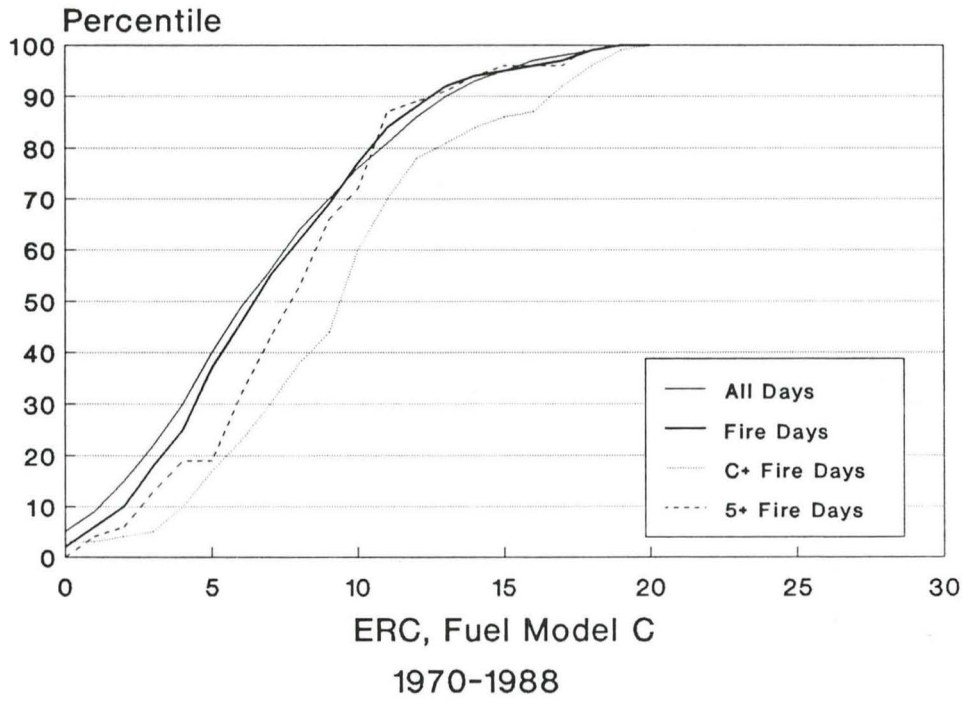

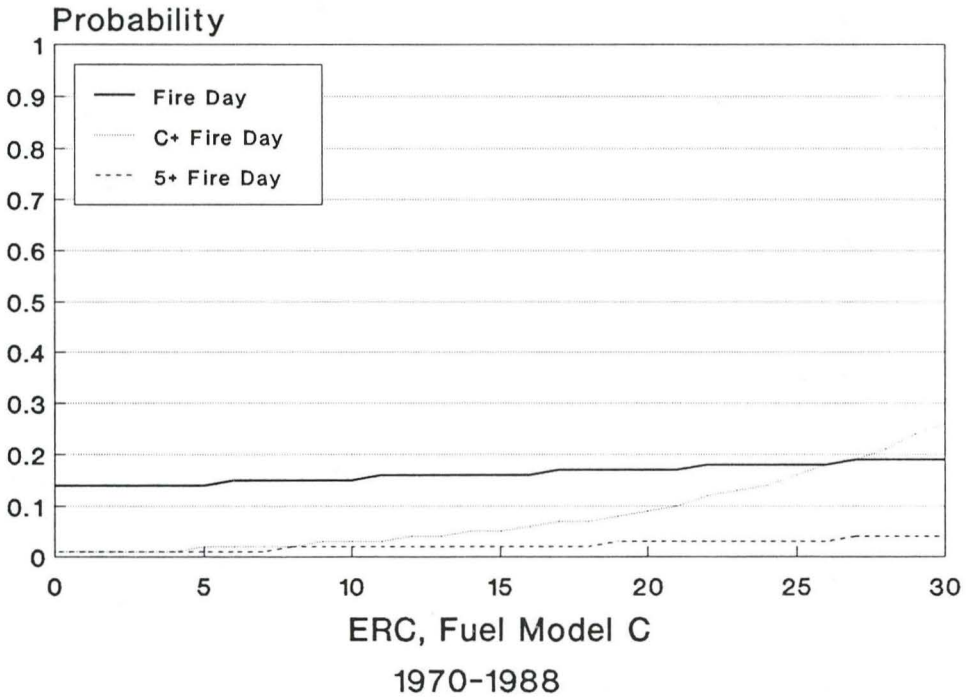
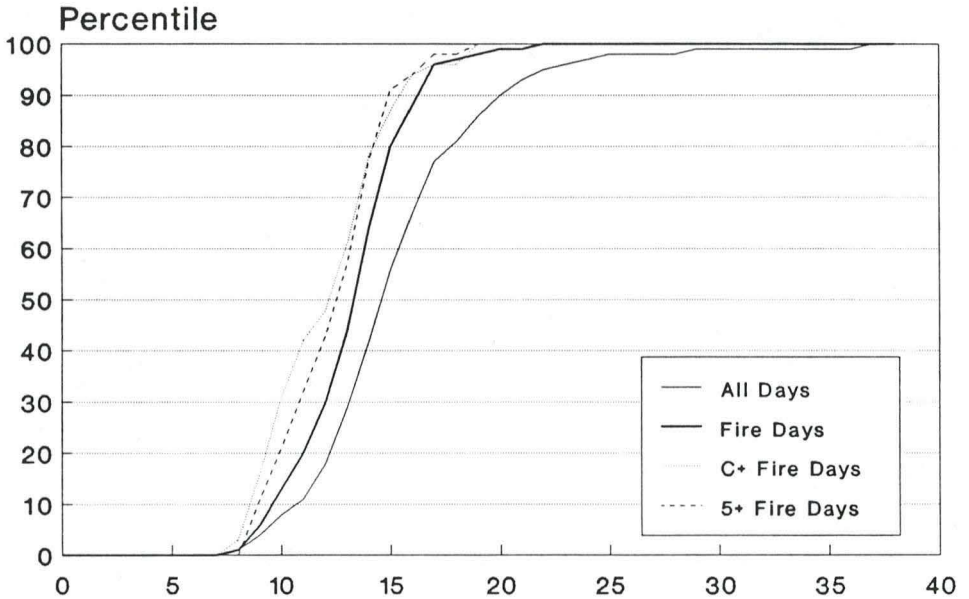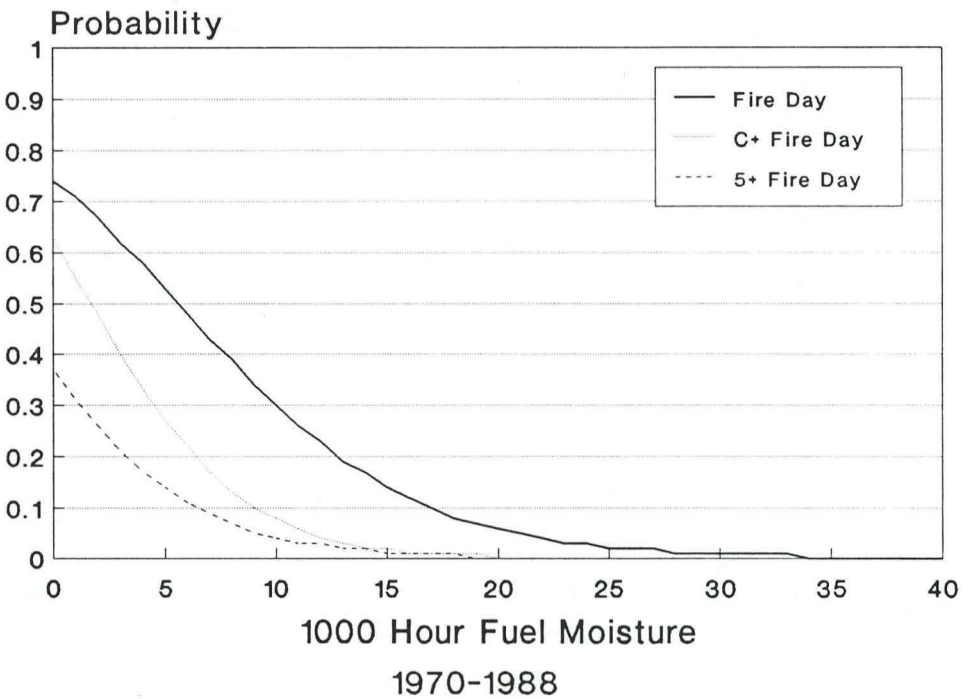
NFDR Map Polygon 11